

"CHRONOTECHNICS OF THE PRESENT, TIME-CRITICAL MEDIA PROCESSES"

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"CHRONOTECHNICS, TECHNICAL TEMPOR(E)ALITIES"

There is time-based, time-critical and time-giving media on the one hand

(part A), while such chronopoetics is suspended in its techno-archival states on the other (part B). Both extremes are defining media tempor(e)ality.

Synchronizations (Present Media Times):

TEMPORALISING THE PRESENT, RE-PRESENCING THE PAST. Towards a media-epistemology of technologically induced temporal affects

Archiving the present & co-presence of the past: A technological Moebius loop

Electronic transduction, the conversion of signals into information units (bits), interactive human-computer interfaces, the speed of micro-processes, recursive algorithms and feedback loops all result in new ways of negotiating "the present".

Technical media know to address human observers and users not only to their eyes and ears, but on their existential level of sensation of being-in-time. So-called "analog", signal-recording media systems like photography or the phonograph have been, for the first time in cultural history, able to technically address, manipulate and challenge human perception in its its most essential sense of being-in-time.

But there is a dissonance between affective and cognitive human experience of times past when coupled to technical media. Here, a dissonance takes place; a gap between technical timing and subjective sensation of time opens. Especially audio-visual media address the human perception on its most essential sensation of being-in-time (both on the level of the physiological senses and in neuronal cognition). Technological media actually generate, store, and re-generate temporal presence, while cultural discourse symbolically frames temporal experience into a "historical" context.

Time-critical action in electronic and digital technologies develops into an epistemology which radically challenges traditional "ground" temporal horizon spanning between a heavy "historical" past and an emphatic future, with a shifting emphasis on actually nonlinear, algo"rhythmic"¹, con-temporary events.

Such augmentation of the present happens in the tight coupling of human time with machine time, resulting in resonant atunement (analog) and high frequency pulsation (digital). Analytical aesthetics deals with

¹ See Shintaro Miyazaki, *Algorhythmics*. Understanding micro-temporality in computational cultures, *online* in: Computational Culture, Issue 2 / 2012; <http://computationalculture.net>

such affective temporalities.² But different from the phenomenological or neuroscientific focus on the human time-window of the present moment (roughly three seconds), media-archaeological analysis concentrates on the techno-mathematical temporal condition of signal processing itself. "Media archaeologists [...] describe the non-discursive practices of the techno-cultural archive. Media phenomenologists [...] analyze how phenomena in various media appear to the human cognitive apparatus, that is, to the mind and senses."³

While the human sense of "the present" is challenged by the immediacy of analog signal transmission and the delays of digital data processing, a different (non-)sense of time unfolds within technologies themselves. At that moment, human-related phenomenological analysis clashes with the media-archaeological close reading of the technological event, in an impossible effort to let the *temporeal* articulate itself.

Technologically induced temporality affects the contemporary in two ways: a) temporalizing and archiving the present (technically corresponding with analog delays and digital intermediary storage), b) re-presencing disembodied faces and voices in shock-like manners since photo- and phonographic recording.

The current transformation of "analog" media recording into the digital one is dramatic for memory culture. In the transformation from analog to digital transmission media, an act of technical archiving takes place, which condenses the heterogeneity of different times into micro-storage.

Whereas analog broadcasting (radio, television) has been connecting the viewer to the event in front on the camera in temporal indexicality ("live" transmission), digital signal transmission is "archival" per definition: it takes intermediary computation ("real time"). Digital media culture is an micro-storage structure - the "algorithmic archive".

The most radical form of "archiving presence" is the encapsulation of intrusive affects; according to Mardi J. Horowitz "a traumatic experience remains in a kind of memory storage". There is a link between the "presence affect" and storage theory. "One of the major features of trauma is its inherent latency of belatedness — the inability of the trauma victim to grasp and assimilate the traumatic existence in real time"⁴ - just like the "latent" electrostatic image in Xerox copying

2 See Eleni Ikoniadou, *The Rhythmic Event*, Cambridge, Mass. / London (M.I.T. Press) 2014

3 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, section 6

4 Mati Shemoelof, *RealityTrauma Alienated Past and Alienated Present: On the Engagement with Nightmarish Light*, in: Avi Ganor, *RealityTrauma*, exhibition catalogue Tel Aviv Museum of Modern Art, 2011, 175-203 (203)

machines, and the phenomenon of magnetic remanence. Latency, here, correlates with the neurological notion of "implicit memory" where contents are not available to consciousness.

In technical terms of digital calculation, the delay is inherent in the notion of "real (signal processing) time" already - different from the time-indexical "live" signal transmission. Trauma studies often lack a close reading of the technologies which are involved. One step further, the media-archaeological approach identifies traumatic tempor(e)alities which have been induced by technology directly.

Disruptions of the present generated from within (and preserved by) technological media

G. W. F. Hegel once defined the tone as transitive being. Such ephemeral cultural articulations have been subject of philosophy for long time. Media archaeology (in terms of technological measuring of a sound as event) allows to ground such insight in the signal event itself. With the emergence of signal recording media like photography, phonograph, cinematography, magnetic tape and finally digital recording, however, technical media allow for capturing the present, resulting in an unforeseen disposal of tempor(e)alities. Such media-induced time shiftings and time axis manipulations - while apparently smoothly integrated into everyday cultural practices - still are an affective shock which the cultural unconscious has not yet fully digested.

"Archiving" the present is understood here not in the passive sense of accumulating signals or data in a structured way, but rather in Foucauldian and Derridean terms as a generating principle (*archive / arché*). Different from what Gumbrecht more recently called "production of presence"⁵, the focus is on technological abilities to generate fuzzy *presents*. The terminological effort of *smear*ed present is deliberately close to the concept of *fuzzy logic* in computing science.

Psychological presence effects for players of computer games emerge in moments of suspense of self-consciousness. The expression "for the present" (which equals *einstweilig* in German) reminds of Husserl's conceptual protention⁶, while retention is "the process by which an awareness of 'now' is synthesized with previous instants held momentarily in consciousness to yield a sense of temporal unity and flow."⁷ The sonic equivalent to this state of extended consciousness of the present is acoustic reverberation; any damped oscillation slowly

5 See Hans Ulrich Gumbrecht, *Production of Presence. What meaning Cannot Convey*, Stanford, Calif. (Stanford UP) 2004

6 See Don Ihde, *Listening and Voice. Phenomenologies of Sound* [*1976], Albany, NY (State University of New York) 2007, chap. 7 "Timeful Sound", esp. 89 ff.

fades away. It is exactly at that point that vacuum-tube based electronic developed the circuit which produces undamped, sustained oscillations as basis for, e. g., radio transmission or synthesizer tones. While the very retentive experience of presence in phenomenology creates the impression of a "living" present exactly because it tends to death (a Heideggerean "being-to-death"), the electronic loudspeaker-based acoustic presence is a timeless present.

The administrative *arché* and the traditional "archive" (the symbolic order as operated in the textual record) has been technologically challenged by non-alphabetical media recordings (starting with photography and the phonograph), allowing for not simply "archiving" presence in the symbolical mode, but to re-store presence to the affective, signal-based level of perception. The tempor(e)ality of affect is now being matched by micro-technical moments of intermediary storage.⁸

Due to the ephemeral nature of its object, the study of presence has become inseparable from the study of its archiving media. Recording media have molded the perception of presence; analogue signal-recording media and recently signal-processing (DSP chip based) media have enhanced the power of generating the affective experience of presence. Recording technology made it possible for the first time to store, repeat, and manipulate presence. An escaping moment (the physical signal) now became an object of communication analysis that could be replicated and analyzed. The different ways of storage result in different ways of re-storing presence both in individual and collective "memory". In digital media, the symbolic regime and signal recording converge: the alphanumeric code, algorithmically processed in hardware-based signal processing.

Different from alphabetically coded memory of the past, signal storage media can immediately re-create the affect of presence in human temporal sensation. What is cognitively known as belonging to the past (the familiar "historical" record) is phenomenologically perceived as affect of presence, resulting in a cognitive/affective gap which has not yet been reconciliated.

While recent research has discovered that the specific phonetic alphabet which is still in current use today has been invented to record, store and transmit the musicality of Homer's oral poetry, a different kind of

7 Joseph Clarke, For a History of Liveness, in the architectural journal: log, vol. 33 (2015, forthcoming), 25-37 (35), referring to: Edmund Husserl, Phenomenology of Internal Time-Consciousness [GO *1928], Bloomington (Indiana University Press) 1964, 52-53, § 12

8 See Peter Hartocollis, Time and timelessness, or The Varieties of Temporal Experience (A Psychoanalytic Inquiry), New York (International Universities Press) 1983, chap. V "Time as a Dimension of Affects", 59-78

alphabet - the digital code - nowadays dominates most processing of cultural communication. The conversion of analogue to digital media archives is not just another mode of cultural memory but a dramatic transformation of its essence. Algorithmic re-presencing needs to be thoroughly reflected by both media and cultural theory.

There are chrono-traumatic irritations of the sense of the present caused by signal recording and data processing technologies. The symbolical or technical inscription of traumatic experience is not only bound to specific historical situations, but rather much deeper rooted within the techno-epistemology of media themselves. From the phenomenological perspective, photography, phonography, cinematography, videography, the magnetic tape, and finally digital recording affect the human sense of time. Although apparently accommodated in every day consumption, this intrusion of the technically recorded past into the present has not yet been cognitively digested and continues to irritate the "cultural unconscious" - an explicit analogy to Benjamin's neologism of an "optical unconscious" which was inspired by Sigmund Freud's psychoanalysis, describing temporal evidence which is not accessible to human senses immediately but with the camera only - in slow motion and fast forward display.

Media-induced irritations of the sense of the present happen in irruptive ways; such incisions of time are traumatic *temporealities* - pluralizing the tightly coupled time triad of past-present-future into a plurality of micro-temporal figures of delay, anticipation and intra-temporal (time-critical) moments. These temporealities share central features with what in academic memory studies has become known as the unhistoricizable of traumatic remembrance. Next to "the distinctive role of media in mediating collective trauma"⁹, there is a traumatic irritation both of presence and the present induced by media technologies themselves. Psychological symptoms like being "out of sync" indicate a micro-temporal irritation; the Lacanean "real" invades the symbolic order as *temporeal* (German *Zeitreal*).

The tempor(e)al in the cinematographic apparatus

[When Chris Marker, in a reflections of his film *Sans Soleil*, tried to remember a January he once spent in Tokyo, he realized that he rather remembered the images he then filmed there - images which had replaced his organic memory by storage media.]

Any cinematographic projection derives from a storage medium (phonotgraphic image series on celluloid). But the professional shooting

⁹ Amit Pinchevski and Tamar Liebes, Severed Voices: Radio and the Mediation of Trauma in the Eichmann Trial, in: Public Culture 22:2 (2010), 265-291 (267)

of a cinematographic sequence is a form of repetitive presence itself: camera shots as intervals which mostly require repetitive shooting ("takes"). Still every "take" - even for the most narrative "fiction film" - is a time-authentic recording, since it is unique in its individual nuances.

Can cinematographic experience be "historicized" and thus be integrated into historical discourse, or does the shock of its oxymoronic power of "re-presencing" (Vivian Sobchack) the dead, the passed, remain a traumatic momentum, that is: not entering conscious symbolical mastering? Has the shock of the first "movie" screening in Paris 1895 been digested in the cultural unconscious at all, or does it insist as a sub-cultural irritation? "As soon as one is aware that a film can be viewed again - that this experience of presence can be repeated - it becomes a record [...]."¹⁰ But "[i]t would be more accurate to say that photography and the cinema produce the sense of a present moment laden with historicity at the same time that they encourage a belief in our access to pure presence, instantaneity."¹¹

Auratic presence and the aesthetics of "live"

Theodor W. Adorno remembers an acoustic scenario where he once was able to compare his actual listening to a nightingale through the open window with the radio transmission of the same bird's song: "[...] the author [...] managed to listen to it over the radio when the windows were open. The result was that we were able to hear the radio nightingale a bit earlier than we could hear the real voice because sound takes longer to reach the ear ordinarily through space than by electrical waves. The real nightingale sounded like an echo of the broadcast one. Thus the 'radio voice' creates a strong feeling of immediate presence. It may make the radio event appear even more present than the live event"¹²

Where does "live" stop and "delayspace"¹³ start?

The destruction of the "aura" of a work of art by technical reproduction (Walter Benjamin) is foremost an intrusion into its temporal structure; "aura" is bound to its specific (almost Bergsonian) time figure, between the temporal now ("the present") and auratic appearance ("presence" and "re-presencing").

10 Mary Ann Doane, *The Emergence of Cinematic Time. Modernity, Contingency, the Archive*, Cambridge, Mass. (Harvard Univ. Press) 2002, 104

11 Doane 2002: 104

12 Theodor W. Adorno, *Current of Music. Elements of a Radio Theory* [1940], ed. Robert Hullot-Kentor, Frankfurt/M. (Suhrkamp) 2006, chap. V "Time - Radio and Phonograph", 120-128 (120)

13 A term coined by Marcus Bastos for his media theatrical performance 2014; <http://www.eventualidades.net/delayscapes>

Technologies of communication are analogous to "those phenomena and conditions that contribute to the production of meaning, without being meanings themselves"¹⁴ - the Kantian *a priori* transformed into a processual element, plausible for the technological production of presence.

It has been a feed-backward effect of recording technologies that made it possible to perceive existing events as "live".¹⁵ The tele-presence induced by electronic images in television news differs from the most determining characteristic of the museum: "the necessary presence within it of objects, things which by their presence in the museum, claim a particular status [...]"¹⁶ - in fact the status of real presence.

But image transmission by the digital camera is not really telepresence any more. The recursive loop between technically mediatized art and "live" art is known from closed-circuit video installations already.

Motion analysis and the "present time window" in neurological terms

"Archiving presence" opens a temporal window of affective indeterminacy, "a zone between a 'not yet' and 'always already over'"¹⁷. In neurological terms, the brain does not store memory images or acoustic melodies respectively rhythms as such but rather operates with *Delta* codification: just the differences between waves are registered.

It is by intervention of measuring equipment like digital motion capturing that what appears like expressions of a continuous present dissolves ("analysis") into micro-intervals of quasi-musical motions. What looks and sounds like a transitive relation between a musician and his instrument, might not be a musical gesture at all but rather a "servo-mechanism" in cybernetic terms of signal communication between the animal and the machine.

(Mass-)Media-induced "traumatic" temporality

If "catastrophe does [...] always seem to have something to do with technology and its potential collapse"¹⁸, the collapse of the TV image of

14 Gumbrecht 2004: 8

15 Philip Auslander, *Liveness. Performance in a Mediatized Culture*, 2nd ed., London (Routledge) 2008, 56

16 Silverstone 1992: 35

17 As expressed in the *abstract* for the symposium *Timing of Affect*, Academy of Media Arts, Cologne, 30 May - 1 June 2013

18 Doane 1990: 229

Rumanean dictator Ceaucescu ("Trasmissione diretta") has been the traumatic message of the medium itself.

Trauma belongs to the essential experiences of technoculture; its defining characteristics is the disruption of time and space¹⁹ Trauma arises with the technological signal recording and - transmitting media themselves (since photography); traumatic time is a non-historicisable experience (eventality), coupled with genuine media time (time-criticality). There is no past in media. Trauma is the non-archivable; its temporal figure is not (historical) narrative but repetition which lends itself to recording technologies.

In his analysis of the photographic moment, Walter Benjamin defines the camera's ability to arrest the ephemeral and the contingent: "The camera gave the moment a posthumous shock, as it were." With the moving photographic image, "perception in the form of shocks" was even established "as a formal principle"²⁰. - which is montage. "The very rapidity of the changing images in film is potentially traumatic for the spectator and allows the cinema to *embody* something of the restructuration of modern perception."²¹ Along with the French *Apparatus* media theory, such kind of non-discursive practices is already embodied in the technical devices itself: in the mechanism of the intermittent image: "They have a knowledge effect."²² "[...] contemporary media technologies serve as the major site wherein contemporary trauma is not just witnessed but actually produced and registered as traumatic in the first place."²³

The techno-traumatic incident already occurred in the very first photographic recordings: taking out of a moment (or interval) out of historical time, an ekstatic temporality, which "mechanically repeats what could never be repeated existentially"²⁴. Once the singular "spark" of the apparent historical accident²⁵ as narrative or dramatic category

19 See the "Introduction" by Mousoutzanis, in: *New Media and the Politics of Online Communities*, ed. by Aris Mousoutzanis / Daneil Riha, Oxford (Inter-Disciplinary Press) 2010 (in eBook format), ix-xix (xvii f.)

20 Walter Benjamin, *On Some Motifs in Baudelaire*, in: *Illuminations*, ed. Hannah Arendt, New York (Schocken) 1969, 174 f.

21 Mary Ann Doane, *The Emergence of Cinematic Time. Modernity, Cinematicity, the Archive*, Cambridge, Mass. (Harvard Univ. Press) 2002, 15

22 Doane 2002: 21, referring to: Michel Foucault, *History of Systems of Thought*, ed. Donald E. Bouchard, Ithaca, N. Y. (Cornell UP) 1977, 200

23 Aris Mousoutzanis, *Cybertrauma and Technocultural Shock in Contemporary Media Culture*, in: same author / Danile Riha (eds.) 2010, 173-180 (*abstract*)

24 Roland Barthes, *Camera Lucida. Reflections on Photography*, New York (Hill & Wang) 1981:, 4

25 Walter Benjamin, *A Short History of Photography* [*1931], in: A. Trachtenberg (ed.), *Classical Essays in Photography*, New Haven (Leete's Island Books) 1980, 199-216 (202)

coincides with technical lightning (the photographic flash or other light-recording), it is transformed into media time, culminating with the electronic image where the cathode ray image is a bombardment of electric sparks indeed. "Ecstatic time breaks with the ordinary conception of time as a succession of 'now' moments and presents us with *truly historic* time: 'moments, when a minute lasts a lifetime, or when a week seems to fly by in next to no time. This is what Heidegger calls 'ecstatic temporality', or time taking place in its authentic moment of ek-sistence'."²⁶

Catastrophe does not only enact a time different from conventional historical experience but is ecstatic towards the parameter of time itself, representing „that which cannot be contained within [...] an ordering of temporality“²⁷. The media situation goes with an "acceleration of its temporality to default 'real-time' reporting"²⁸.

Not the visual "content" of the representation as such but its temporal instantaneity is the traumatizing momentum. Therefore TV live transmission of the 9/11 attack has been *participative* itself, as Paul Virilio commented.²⁹

Crisis-readiness roots in communication engineering itself. Both Wiener by "harmonic analysis") and Shannon (by stochastic analysis) treated the scenario of an enemy air plane approaching its target and the correlative anti-aircraft artillery reaction as an act of "communication".

The contemporary routine background condition of persistent crisis-readiness³⁰ is a function of the time-critical conditions of media technologies themselves. The category of crisis has traditionally been bound to human agency³¹; in times of electronic signal processing crisis witnessing is not an exclusive human capacity any more. The permanent state of alert commonly associated with "live" broadcasting and "breaking news" editing is an emanation of the essence of electronic

26 Lillie Chouliarki, *The Spectatorship of Suffering*, London et al. (SAGE) 2006, 158, referring to: C. Barker, Alain Badiou. *A Critical Introduction*, London (Pluto) 2002, 75

27 Doane 1990: 233

28 Frosh / Pinchevski 2009: 303

29 "Es gibt eine Mitschuld der Medien, auch wenn sie eine indirekte ist. [...] Zur Diskussion stehen dabei keineswegs die Fotos von einem Ereignis, sondern die Livebilder." Der Mann, der am 11. September nicht vor dem Fernseher saß: Ein Interview (Jürg Altwegg) mit Paul Virilio, in: *Frankfurter Allgemeine Zeitung*, 20.09.2001, Nr. 219, 49

30 Paul Frosh / Amit Pinchevski, *Crisis-Readiness and Media Witnessing*, in: *The Communication Review*, vol. 12 no. 3 (2009), 295-304 (*abstract*)

31 M. A. Doane, *Information, crisis, catastrophe*. In P. Mellencamp (ed.), *Logics of television: Essays in cultural criticism*, Bloomington, Indiana and London (Indiana University Press and the British Film Institute) 1990, 222-239 (223)

media: the speed electro-magnetic waves and the real-time paradigm in digital signal processing. The focus thus shifts from the human witness augmented by mass media to an analysis of signal and data processing *within* the technologies involved.³² The technologically induced witness affect results in "crisis-emotions among those who were not physically present at the event but nevertheless feel themselves affected by it"³³.

Different from microtime-sensitive measuring devices, there is (at least for humans) no perceptible difference between the "live" transfer of electric signals and their replay from from phonograph, magnetic audio or video tape, or digital storage disc. Such replay does not come from memory but is signal-technical "re-presencing"³⁴.

The affect of the *instant* is not simply a discursive effect or a phenomenological perception but the temporal essence of electro-magnetic wave propagation itself: almost no *Dt*. When Walter Benjamin defines the singularity of the instant as "the spark of accident"³⁵, this spark is no metaphor but operates literally in electronic media - a pure function of technological temporality (*tempaurality*)

Different from electronic live transmission in radio and television, cinematographic images can not testify real time, since the time of recording and the time of replay are separate. The moment of projection has no inherent relation to the temporal scene (chronosphere) caught in the images³⁶

Instantly recording the present

Against the user claim for immediately fetching all kind of data, restricted access has been an old archival virtue of temporal defer to be rediscovered - with a view on the essence of academic university as well. Online access to data results in a culture of "immediacy, whereas traditional (academic) knowledge require delay in reflective thinking."³⁷

32 As encompassed by the definition of *media witnessing* as "the witnessing performed in, by, and through the media ": Frosh / Pinchevski 2009: 296

33 Frosh / Pinchevski 2009: 301

34 On that term see Vivian Sobchack, Afterword. Media Archaeology and Re-presencing the Past, in: Erkki Huhtamo / Jussi Parikka (eds), Media Archaeology. Approaches, Applications, and Implications, Berkeley / Los Angeles / London (University of California Press) 2011, 323-333

35 Walter Benjamin, A short history of photography [1931], in: A. Trachtenberg (ed.), Classical Essays in Photography, New Haven (Leete's Island Books) 1980, 199-216 (202)

36 See Kerstin Volland, Zeitspiele. Inszenierung des Temporalen bei Bergson, Deleuze und Lynch, Wiesbaden (GWV Fachverlage) 2009, 92

37 Marquard Smith, Theses on the Philosophy of History: The Work of Research in the Age of Digital Searchability and Distributability, in: Journal of Visual

There has been a remarkable media-technologically induced difference between the situation of people waiting at St. Peter's Cathedral in Rome for the new pope to be announced in 2005 (Benedict XVI) and in 2013 (Francesco)³⁸, from continuous eye-witnessing of the present moment to I-pad-augmented witnessing. Time-discrete photo-testimony is a kind of macro-sampling of the present (which micro-technologically happens in the sample-and-hold mechanism of analog-to-digital conversion itself).

Different from the archive which is symbolical order, recorded by symbols (alphabet), thus: spatial orders, audio-visual media record signals which are physically functions of time; this becomes apparent in, e. g., Gordon Bell's *My Life Project* recording project, operated by the permanently worn data eye-glass. When these are being re-played, our senses are affected, in a non-historical way. There is no memory here, presence happens, like any electronic re-play is dynamic. Instead of psychoanalytic trauma-research now: an analysis of the techno-traumatic momentum (traumatic irritations of re-presencing induced by analog and digital technologies, such as the phonograph once and the real-time, that is: techno-archival present in Web 2.0 cache memories of short-time data buffers and registers.

Duration is the conceptual contrast, as defined in Henri Bergson's *Creative Evolution*: "For our duration is not merely one instant replacing another; it it were, there would never be anything but the present [...]. [...] Memory [...] is not a faculty of [...] inscribing them [sc. recollections] in a register." There is no register, different from stored-program computing (the familiar von-Neuman architecture) where the register figures centrally within the CPU to operate at all.

Another case is Finnish media-artist Erkki Kurenniemi's audio-visual self-recordings over decades, from analog to digital devices.³⁹ "We would make a mistake if we think that, in contrast to Erkki's attitude towards presence, we could refer to a 'normal' sense of presence in the present: to an unmediated, integral presence. Nothing as such exists either. We are always anticipating and deferring, missing the presence. But if we all 'live with it', Erkki has articulated his life around it and explored the full consequences of the utopia of a divisible present in both existential and technological terms. Films, images and videos, here, are time capsules. But not of any time, but the time of a deferred, diminished presence. To begin an archive based on documents of such a nature means first to

Culture, vol. 12 (2013), 375-403 (380)

38 An argument by Angela Maiello (PhD student, University of Palermo), research presentation at the colloquium *Medien, die wir meinen*, Humboldt University Berlin, summer 2013

39 Joasia Krysa / Jussi Parikka (eds.), *Writing and Unwriting (Media) Art History*. Erkki Kurenniemi in 2048, Cambridge, Mass. (MIT Press) 2014

negotiate a debt. An archive would need to give back the presence that Erkki took away from his life moment by moment."⁴⁰

The new immediacy of archival time in terms of *online* accessibility and instant re-play may be compared to a situation from the area of visual recording of movement. The production and projection of documentary film since the beginnings of cinematography had been a rather heavy and slow apparatus-dependent process, and copies were expensive. Around 1968, with the arrival of the first Sony "portapacs" as portable video recorders (used, e. g., by Nam June Paik), "meant a breakthrough, because you could immediately play back what you had recorded."⁴¹

Archives have always been summoned "to give back time" - which requires that they first withdraw data from the temporal economy of the present (as represented in the practice of immediate access on the Internet). "But what if they are asked to give back presence?" <Constant *ibid.*>.

Erkki Kurennimi's self-recording (which has been pornographic to a large degree) oscillates between the obsession of memoryless, libidinal consumption of the present, and the pleasures of its immediate recording.

The event is the signal: "live" TV transmission

Just like phonographic signal recording, video transmission and recording can not but register even stillness as "moving" which is the physical nature of the time-signal and the rotating or scanning apparatus itself, performing what mathematics names an "integration" of the recorded movement.

At the moment of the catastrophe seconds after launching the Challenger space shuttle in the US, "[...] television itself was on the scene - witness to the catastrophe. And the played and replayed image of the *Challenger* exploding [...] constant evidence of television's compulsion to repeat - acts as a reminder not only of the catastrophic nature of the event but also of the capacity of television to record instantaneously, a reminder of the fact that television was *there*. The temporality of catastrophe is that of the instant."⁴²

40 Constant, Erkki Kurenniemi (In 2048) (preliminary work towards) an online archive; *online* <http://kurenniemi.activearchives.org>

41 Tjebbe van Tijen, We no longer collect the Carrier but the Information, interviewed by Geert Lovink, in: MediaMatic 8#1 (January 1994), *online* <https://www.mediamatic.net/en/page/12834/we-no-longer-collect-the-carrier-but-the-information>, accessed November 27, 2018

42 Doane 1990: 231 f.

When at the notorious press conference on Thursday evening November 9th, 1989, in Berlin, the spokesman of the central GDR government Schabowski, by mistake, announced the implementation of the new liberal travel regulations for East Germans as "sofort" ("immediate"). This enunciation of "sofort" was technically transmitted "immediately" as well, as a live signal by television and radio indeed. In the public, this triggered an immediate rush to the border gates and the opening of the Berlin Wall since their claim to the border police was faster than the East German political, or Russian troops military administration, could react to, or correct, in real time.

[The public printing press, due to its latency in the processing and production of news, could declare the new travel regulations, in a more official, regular formulation, only on next day Friday. As the head of the East Berlin department for passport and registration, Major Dieter Graeber, answered to journalist Peter Schubert's question "Wann und wie erfuhr die Volkspolizei von den neuen Reiseregulungen?" in the newspaper two days after the event: "Eigentlich im Augenblick ihres Inkrafttretens, als sie im Fernsehen, in der 'Aktuellen Kamera' bzw. bei der Pressekonferenz mit Günter Schabowski verkündet wurden. Wir reagierten darauf mit einer buchstäblichen Mobilmachung aller nur verfügbaren Kräfte, um den zu erwartenden Ansturm der Berliner auf unsere Meldestellen und die Grenzübergänge Herr zu werden."⁴³

The techno-traumatic momentum is not restricted to "historical" incidences like resulting from the "nine-eleven" terrorist attack on New York in 2001 as televisual witnessing⁴⁴, or other kinds of mediated Post-Traumatic Stress Disorder⁴⁵, but actually already results from the subliminal irritations and micro-shocks which are technologically induced in human perception once coupled to recorded or transmitted voices, images, or computational intelligence at all.

Until recently, radio and television, and nowadays mobile media "greatest technological success has been its ability to be there - both at home and ubiquitous. "Hence the most catastrophic of technological catastrophes is the loss of the signal"⁴⁶. One effect of real-time digital video and sound transmission of events is that their "witnessing" on its most essential technological level loses its indexicality.

⁴³ Interview " Großer Andrang durch neue Reiseregulung" in the East Berlin newspaper Berliner Zeitung No. 266, Saturday / Sunday 11 / 12 November, 1989, p. 16

⁴⁴ See Doane 2002: 13 ff.

⁴⁵ See chap. 3 "Screen Trauma", in: Amit Pinchevski, Transmitted Wounds. Media and the Mediation of Trauma, New York (Oxford University Press) 2019, 65-86

⁴⁶ Doane 1990: 238

Schabowski's "sofort": the asymmetrie between "live" signal transmission in radio and television, and architectural walls

In vehicle transport sensation, the intercontinental flight experience of "jet-lag" indicates a delayed, "deferred present", a differential time experience where time is physically experienced *transitively* while emerging in transition, an irritation of the present literally *on the fly*.⁴⁷

On the micro-temporal level of tele-communicative signal transmission, in "inner time consciousness" (in Husserl's sense), though, "live" transmission is phenomenally experienced as immediate - which corresponds with its strict electro-physicality, the speed of light in electro-magnetic wave propagation.

Electro-magnetic induction itself induces what Heidegger termed "ecstatic" temporality in *Being and time* (1927) which differs from time as succession, like the momentary event of the soccer goal transmitted in live television. Here, the "Augenblick" corresponds with the ecstatic "now"⁴⁸, "realtime history" like Beckham's goal during the World Cup in Germany 2006. "The goal, when it came, struck like a flash of lightning. There and gone in an instant. And yet everything was now transformed - an electrifying moment"⁴⁹, *electrifying* in a media-literal sense, since: "The aliveness of tele-technologies is the effect of the power (energy) source that is the condition of their possibility; namently electricity."⁵⁰ This is the Foucauldian *a priori* in times of technical signal transmission media.

The collapse of the Berlin Wall, in the night of November 9th, 1989, has been an effect of such *non*-delayed televisual presence, in its inherent urban *technopolitics*.⁵¹ At a press conference in East Berlin, the spokesman of the ruling Socialist Unity Party of GDR (SED) Günter Schabowski was asked upon the enactment of the new unrestricted travelling opportunities for East German citizens. His verbally articulated answer "sofort" ("immediately") coincided with its electro-magnetically immediate, *live* signal transmission, resulting in an immediate run of East Berliners to the gates of the Berlin wall. The narrative sequence of events which is the traditional condition for historical events was compressed into almost no delay, faster than any administrative or military chain of communication could ever react.

47 For an analysis of such phenomenological time, see Sara Scharma, *In the Meantime. Temporality and Cultural Politics*, Durham, NC (Duke University Press) 2014

48 Paddy Scannell, *Television and the Meaning of Life*, Cambridge (Polity) 2014, 188

49 Scannell 2014: 173

50 Scannell 2014: 48

51 See *Technopolitics Salon* "Media archeologies of the present", xxx, Berlin, 28th January 2016

According to Walter Benjamin's *Theses on the Notion of History*, dialectic history "flashes" like an image to be seen never again - which is indirectly a description of the electronic image. The irritation of the human sense of the present by electronic media of "live" transmission operates in the hidden mode; only subconsciously humans register micro-moments of delay.

[Benjamin wrote this before video tape recording from television arrived; in fact since 1963 videotape machines (just like the subsequent video-disc) allowed for the *instant replay* of decisive moments in sporting events. The instant, once the temporal icon of pure present, became iterative; extended (or rather: distanced) presence by signal recording in fact transforms delay into the archive.]

The scripted talk in radio and television was once introduced against the risks of unsheltered unscripted commentary in live transmission and "breaking news".⁵² Different from cinema-montage which allows for dramatical time order since it is a storage medium, electronic, signal-based media and their adequate format of "breaking news" in television, rather relate to the experience of contingency. The significance of the electronic media event is in its temporal immediacy, "where the referent becomes indissociable from the medium"⁵³ whose message is "live" signal transmission.

Faster than "live", "less than no time": Telegraphy, coding, and the undertunneling of the transmission channel"

In nineteenth century already, the electric telegraph increasingly separated communication of information from physical transportation, delivering messages faster than mobile vehicles could ever achieve.

In the same époque, the psycho-physiological discovery of the "tenth of a second" as perceptual unit of presence coincided not only with the chronophotographic analysis of motion and the cinematographic frequency of image projection to produce the impression of a continuous movement, but as well with the "dot" and "dash" rhythm of telegraphic communication. In fact, their measuring and transmission instruments were cooriginary. Commenting on "modern communication", Thomas Edison's chief laboratory engineer remarked: "We all live on a tenth of a second world."⁵⁴

52 Scannell 2014: 114

53 Mary Ann Doane, Information, Crisis, Catastrophe, in: Patricia Mellencamp (ed.), *Logics of Television. Essays in cultural criticism*, Bloomington / Indianapolis (Indiana UP) 1990, 222-239 (222)

54 A. E. Kenelly, *The Metric System of Weights and Measures*, in: *Scientific Monthly* 23, no. 6 (1926), 551, quoted here after: Jimena Canales, *A Tenth of a*

The essence of the temporal economy of tele-communication is capitalist chrono-logics, as remarked by Karl Marx in 1857: "[...] while capital must on one side strive to tear down every spatial barrier to intercourse, i. e. to exchange, and conquer the whole earth for its market, it strives on the other side to annihilate this space with time, i. e. to reduce to a minimum the time spent in motion from one place to another"⁵⁵ - as already remarked by Heinrich Heine, in his 1844 comment on the opening of a new railway line between Rouen - Paris, "killing space by time".⁵⁶ But the transformation into a different kind of temporal suspense of such shrinking delay intervals (in German literally *Nachträglichkeit*) known from postal communication, in times of mathematically informed, is binarily coded data transfer.

In current communication culture, there has been not only a "transsubstantiation" (a term borrowed from Christian liturgy) from conventional communication infrastructures to media networks, but within technologies itself: from "analog" to "digital". In algorithmically compressed, coded transmission, the quality of live transmission collapses into "real-time".

There is a recursion of telegraphic (that is: symbolically discrete) signal transmission in digital broadcasting: "[...] new media via cables or satellite reconstruct media temporal configurations by the acceleration and compression of time."⁵⁷ This happens within such signal transfer technologies itself: audio and video compression is a core operation for digital signal processing in streaming media. The Internet provides for (almost) immediate electronic copies of binary values stored in central servers - rather topological than transmissional (in the traditional signal broadcasting sense).

Douglas Rushkoff's *Present Shock*

Technological control over time becomes universal in turingmachine time.

"[N]o matter how precisely we can count our milliseconds, neither our bodies nor our businesses are proving as programmable as our computers. [...] While our technologies may be evolving as fast as we

Second. A History, Chicago / London (Univ. of Chicago Pr.) 2009, 5

55 Karl Marx, Grundrisse. Foundations of the Critique of Political Economy (Rough Draft), Harmondsworth (Penguin) 1973, 538 f.

56 See Roland Wenzelhuemer, Globalization, Communication and the Concept of Space in Global History, in: Historical Social Research, vol. 35, No. 1 (2010), 19-47

57 Mira Moshe, Media Time Squeezing: The Privatization of the Media Time Sphere, in: Television & New Media 13(1), 2012, 68-86 (73)

can imagine new ones, we humans and our culture evolved over millennia and are slower to adapt. The body is based on hundreds, perhaps thousands, of different clocks, syncing to everything from the sun and moon to levels of violence and available water. We can't simply declare noon to be midnight and expect our body to conform to the new scheme as if it were a Google Calendar resetting to a new time zone. Neither can we force our businesses to conform to an always-on ethos when the people we work with and for are still obeying a more deeply embedded temporal scheme."⁵⁸

Communicational connectivity of being always-on is an affordance of electronic media. But only when combined with mathematical intelligence, the punctual present explodes into the multitude of real-times.

Rushkoff defines presentism as a result of the pervasiveness of digital technology where everything is "now", but the very term *now* still continues a metaphysical concept of the present. What really puts the term into quotation marks is real-time signal processing which in fact achieves a dissimulation of the "now" itself.

"Each moment is a new decision point more than it is part of some journey through time. In digital media, we are participating in a real-time event, not being taken along some linear path."⁵⁹ What articulates itself through Rushkoff's *persona* is the message of hypertextual Internet communication topology itself.

The present condition, as analyzed by Rushkoff, has become contemporary in its literal sense: living in real-times, communicating instantaneously, co-existing simultaneously, being always-on, in post linear time - even timeless.

At the same time, the computational condition of data-processing in the present is de-archiving: moving programs and data from the hard drive to the Random Access Memory. Random access to intermediary storage devices is a mode of fuzzy present as opposed to the Read Only Memory frame of the conventional nation-state.

Rushkoff defines the "present shock" as a kind of timelessness. "We are becoming an a-historical society, with no sense of story, [...]. We're going from a world where we find meaning over time to one where we do it in

58 Adapted from Douglas Rushkoff, *Present Shock. When Everything Happens Now*, New York (Penguin) 2013; <http://www.rushkoff.com/blog/2013/3/14/wall-street-journal-adaptation-from-present-shock.html>; accessed November 4, 2013

59 Rushkoff, in: Andrea Huspeni, *For Douglas Rushkoff the future is now - and that's the problem*, edited and condensed interview, March 21, 2013, in: *PandoDaily*; <http://pandodaily.com/2013/03/21/embargo-321-how-present-shock-is-shaking-up-the-startup-world>; accessed November 4, 2013

the moment. It's a digital society, where everything is a sample or a duration."⁶⁰ Is culture prepared for digesting this tempo-real irritation of its traditional symbolic time order, or will it results in an ongoing traumatic disorder of times out of joint? "[...] we begin with some wobble — the kinds of initial reactions to a presentist, real-time world. But slowly, over time, we become more mature in our ability to deal with this new temporal environment" (ibid.).

Time-Critical Signal Manipulation of the Present: Digital Video Recording

Digital video recording is an almost dialectic interlacing of cinematography on celluloid and electronic live image transmission: "In the convergence between a repetition and a renewal lies the tendency to archive while bringing forward: past and present instantly simultaneous in the fragmented image. While it loops the past, the digital creates an image of an archival strategy where time passed becomes constantly accessible for the future. [...] reality's duration seems to have become a continuous stream of information potentially open for another time."⁶¹

Digital recording does not require the delay time of chemically "developing" the negative on celluloid any more but renders immediate monitoring functions. Different from the well-acquainted monitor function known from video camera recording on tape and live television, the digital moving image recording allows for immediate intervention. "[D]igital equipment has been built on this ability of storing information efficiently for the purpose of immediate and direct access to, and interaction with, it. What is stored on a hard drive are data that can be retrieved via a number of points or routes as made possible by the RAM"⁶², governed by the agency of the operative algorithm and resulting in an algorithmycised present.⁶³

Archival manipulation of the already present: Real-time editing

Visible Cities, created in 2009, is a webdocumentary and multi-screen installation, developed by the LAT-23 collective in Sao Paulo, Brazil.⁶⁴ "The online version generates automatic clips of 8 minutes, by randomly mixing pre-recorded and live footage from webcams organized in sets of

60 Rushkoff, in: Huspeni 2013

61 Markos Hadjioannou, *From Light to Byte. Toward an Ethics of Digital Cinema*, Minneapolis (Univ. of Minnesota Pr.) 2012, 174

62 Hadjioannou 2012: 201

63 Shintaro Miyazaki, *Das Algorithmycische. Microsounds an der Schwelle zwischen Klang und Rhythmus*, in: Axel Volmar (ed.), *Zeitkritische Medien*, Berlin (Kulturverlag Kadmos) 2009

64 Denise Agassi, Marcus Bastos, Claudio Bueno and Nacho Durán

pre-defined tags and listed on the project's database. The installation version fill a darkened room with 5 monitors that display the live cameras, organized according to a collection of tags periodically sorted. The premise is that intermittent images of a place result in a situation opposite to the one to be expected."⁶⁵ The automatic editing process creates films that evolve in real-time from algorithmic decisions:

"Visible Cities aims to subvert the logic of filming and editing typical of cinema and video, with procedures of capturing online signals and tagging the resulting materials. The goal is to produce films in which live footage produce unexpected results. It is impossible to anticipate what the online webcams embedded on the project's database will display. By aproximating them by a combination of tagging and spatial proximity, the piece stimulates arbitrary relationships between distant places" (ibid.).

The footage is already existing, but the spatial relations and order in which it will be displayed is generated every time the user clicks on the play button. Like George Legrady's installation *Pockets full of Memories*, this kind of Self-Organizing Map relates to genuine computer art which is generative aesthetics (Max Bense et al.). When the images are edited through programming rules, the algorithmic collage replaces narrative dramatization.

Media analysis of the present in high frequency

It takes an observational difference to clearly separate actual news (information) from the redundant archival accumulation of data from the past. On the final announcement in the radio play *Vergiss nie, was du gesehen hast*, broadcasted 24th of June, 2013, at Deutschlandradio Kultur channel, the editor "m" writes on 26 June: "The news message at the end of the play" - an US-American bomb attack on Iraq nuclear plants - "of course, is part of the fictive drama and the end of a bitter story by the Finnish author Illka Remes." What in a dramaturgical con"text" serves as a "authentification signal" is not identifyable as fictive in the time-critical context, when listened to just as final part of the radio play itself - which then sounds like "breaking news". Instead of the cultural / semiotic con"text" there is a temporal context, better called: synchrony, which - when interrupted - creates the traumatic intrusions of the *War of the Worlds* effect achieved rather in the notorious radio play adaption (Orson Welles) than in H. G. Wells' literary version itself.

65 Marcus Bastos, *Eventuality: Designing Real Time*. Lecture Notes, in: *Computer Society (Proceedings of Human Interaction 2014 Conference)*, Heidelberg (Springer), 2014

A culture of "TV on demand" in the Internet (based on the electronic archive) replaces live TV. Even streaming media involve micro-temporal storage (the necessity of buffering a whole frame, which opens a juridical door or copyright violation claims).

It was in 2006 that the BBC ("The Future of Television is on demand") based on a digital archive allowed for "seven day catch up", followed by ZDF in Germany (*Mediathek*) soon after.⁶⁶

From "archiving" presence to delayed presence (a question of storage theory, the question arises: When does "transmission" end and "storing" start?: A radio conversation broadcasted on German FM radio Kulturradio in the morning of 24th October 2013 at around 8.25 a.m. was finally supplied with the information that the conversation had been recorded an hour ago. Ironically, the talk was about the supposed interception of chancellor Angela Merkel's private cell phone by US intelligence service NSA.

As pointed out by Timothy Barker⁶⁷, cinema separates movement into stills, television fragments images into discontinuous lines and the digital computer converts signals into bits. This results in new, discrete temporalities which on the discursive surface are documented by performative practice ("social media").

High-frequency uploads and "streaming media" *online* religates the formerly separate ("secret") archive to the almost immediate present (depending simply on bandwidth and channel coding conditions). Formost the financial markets are now based on the time-scale of high frequency computing, resulting in fluctuations and rhythms which nano-temporally subvert the notion of the present moment itself. The trading floor turns into media theatre. Media and cultural theory has so far attempted to account for such media-induced temporalities in terms of acceleration and speed.

In algorithmic computing, there is a radically new quality of the way times are operationally engineered - what Boris Groys refers to as perpetual series of presents.⁶⁸ The symbolic order of cultural time which has so far been based on the clearly separated temporal categories past, present, and future, implodes into operative anachronism. Technological

66 See Günther Schatter, Zeitsouveränität und elektronisch Medien. Das Programm und seine schrittweise Selbstaflösung, in: Klaus-Dieter Felsmann (ed.), Der Rezipient im Spannungsfeld von Zeit und Medien, Munich (kopaed) 2008, 53-67 (63)

67 See Timothy Scott Barker, Re-composing the Digital Present, in: Contemporaneity: Historical Presence in Visual Culture, vol. 1, no. 1 (2011), 88-104

68 Boris Groys, Comrades of Time, in: D. Hauptmann / W. Neidich, Cognitive Architecture, Rotterdam (010 Publishers) 2009, xxx

devices that sample the present techno-mathematically "analyse" time through Fourier Transform.

In the media-economy of high frequency trading, the beast are time-beasts. The time lense shifts from macro-temporal economical cycles to micro-temporal intervals. At places such as the virtual Stock Exchange, time-critical temporalities become economical temporealties. High Frequency Trading operates with time-"hiding" purposes like these, just like perceptual experiments in the 1960s: smuggling ultra-short moments of Coca Cola advertising into a regular TV movie, not consciously noticed by the viewer. Time-critical economy works especially in businesses.

The algorithmic non-present

It is in the very time-critical nature of stored-program computing (in the so-called von-Neumann architecture) that the present infinitesimally implodes. When *in being*, a techno-logically implemented algorithm makes the digital computer operate in multiple cycling-units, while at the same time adhering to its "one step at a time" imperative of linear (as opposed to parallel) processing. There is no actual present moment until the program comes to an result. The present rather has to be induced by observation, e. g. in the debugging mode where the actual computing can be frozen into a single step or machinic "state" (Turing's term⁶⁹).

Traditional and posthuman understanding of affect

The cybernetical assumption of co-original (therefore analogous) signal processing in animals and machines (Norbert Wiener) results in combined human-machine systems. The cybernetic organism incorporates exogeneous components extending the self-regulatory control function in order to adapt it to new environments."⁷⁰ From this derives a guiding hypothesis for the current project: This cybernetical assumption counts for the *temporal coupling* of human and (chrono-)technologies as well. Once human perception is "tightly" (Fritz Heider) coupled to a technical medium, it is subject to its technological tempor(e)alities; Henri Bergson's *Matière et Mémoire* describes the interlacing of present perception and past recollections as electric circuitry indeed. The affordance (Heidegger's *Zuhandenheit*) of new time technologies not only shapes but generates temporal consciousness.

69 Alan Turing, On Computable Numbers, with an Application to the Entscheidungsproblem, in: Proceedings of the London Mathematical Society (2), vol. 42(3) 1937, 230-265

70 Paul N. Edwards, The Closed World. Computers and the Politics of Discourse in Cold War America, Boston, Mass. (MIT) xxx, chap. 9, note 1 (referring to Manfred Clynes / Nathan S. Cline, Cyborgs and Space, in: Astronautics, September 1960)

When humans are in the Internet browsing state, memory there is not past, but a spatio-temporal latency.

Different from Henri Bergson, Gilles Deleuze detaches the affect from the subject-body and rather locates it within the techno-corporeal assemblage⁷¹ - which results in a techno-trauma indeed. This becomes evident in electronic imagery and the "scanning finger" (McLuhan) of the cathode tube ray in analog television and video as such: "It addresses our nervous system directly. It creates a being of the sensation that exits in itself and reveals to us a state of becoming-nonhuman"⁷² in terms of a "pre-personal perception"⁷³.

"[A]n understanding of the messy materialities of affective regimes stems largely from nineteenth-century physiology, experimental psychology and a variety of scientific and experimental measurements [...]. In other words, there is a media-archaeological side to the notion of affect as well."⁷⁴

The micro-temporal momentum of affect

Affect is a signalling of a non-discursive, non-narrative traumatic timing. The co-origin of trauma studies (Freud) and technical cinematography around 1900 is not coincidental in itself. To formulate it rather in engineering than in psychological terms, there is human perception of signals in the Low Frequency Band of which the mind is consciously aware (like audio signals between 16 Hz and around 16 kHz), as opposed to signals in the High Frequency Band which are there but not perceivable for human senses - a sublime existence. There are time events (and their manipulations) of which humans are simply not aware, just like radio and television transmission as technical event (carrier frequencies). But still they *result* in affective modulations of human sensation - indirectly, as *sublime tempor(e)ality*.

The tempor(e)ality of a deferred present becomes evident from experiments on the formative interval of perception, a micro-temporal lag between the brain activity initiating a movement and the conscious registering of the decision to act. The notion of delay, for technologies of telepresence, is a rather alien idea; it is the metaphysics of the instant which buttresses their contemporaneity. Regarding the techno-traumatic tempor(e)ality flashing from electronic television is bound to the

71 See Mark B. N. Hansen, *New Philosophy for New Media*, 32 f.

72 Mark Hansen, *Deleuze and the Three Powers of Literature and Philosophy*, in: *Deleuze and Guattari. Critical Assessments of Leading Philosophers*, ed. Gary Genosko, London / New York (Routledge) 2001, 207-222 (216)

73 Claire Colebrook, *Gilles Deleuze*, London (Routledge) 2002, 38

74 Jussi Parikka, *What is Media Archaeology?*, Cambridge / Malden, CA (Polity Press) 2012, Introduction, 30

temporality, the difference between analog and digital becomes literally "decisive", since sudden change (catastrophe) corresponds with digital switching: "The time proper to catastrophe might be thought of as compatible with that of the digital watch where time is cut off from any sense of analogical continuity, and the connection between moments is severed. One is faced only with the time of the instant - isolated and alone."⁷⁵ This is true, though, since the implementation of the escapement-controlled mechanically wheeled clock.

Technologically induced micro-traumatic moments escalate with the rupture between mechanical cinematography and electronic (analogue) images: "With film, the brain does not 'fill in' the images on the screen - it fills in the motion between images. With television, the brain must fill in (or recall) 999.999 percent of the image at any given moment, since the full image is never present on the screen."⁷⁶ The "given moment" is time-"data"; absence is being micro-temporalized, towards the "tempo-real".

Affect is not only a mode of temporal experience, but itself a radically time-critical form of perception. According to Brian Massumi, affect precedes consciousness within human signal processing, as demonstrated by registering an electric impulse on the skin.⁷⁷ Thus a disruptive gap between affective and conscious ("thoughtful") perception of one and the same micro-event takes place, resulting in an affective/cognitive temporal dissonance - in fact the traumatic tempo-momentum.

Once photography, the first autonomous media agency in its modern sense, became subject of the archive, the sense-affective, presence-generating power of signal-based media cuts short the distance which is a prerequisite for *historical* analysis, in favor of mnemonic immediacy - the "electric" moment, a shock for the affective experience of temporal presence and past.

It has been Hermann von Helmholtz who detected that the run-time (speed of propagation) of signals in the motoric nerves of a frog counts around 24 meter/sec. This speed recalls a synchronization problem within humans, when technical audio-visual synchronicity might lead to irritation when compared to physical signal run-times in real nature⁷⁸; a lightning stroke is seen more immediate than the accompanying thunder is heard. For the temporal domain of human perception, the media

75 Doane 1990: 238, note 3

76 Tony Schwartz, *The Responsive Chord*, Garden City, N. Y. (Anchor) 1974, 16

77 Brian Massumi, *Parables for the Virtual*, Durham / London (Duke UP) 2002, 28f; see Barker 2012, 87

78 See Uwe Sander, *Die "fehlende Halbsekunde"*, in: *Handbuch Medienpädagogik*, Berlin / Heidelberg / New York (Springer) 2008, 290-293 (292)

psychologist Herta Sturm once experimentally explored that while every day perception which always includes a slight temporal delay of reaction involving a kind of inner, subvocal speech⁷⁹, electronic media force their audience into immediate affection. *Immedia* interfaces deprive humans of their natural chance of delayed perception. Does nothing or everything happen within this half-second? Electronic immediacy, the almost missing micro-temporal gap, results in asynchronicity in signal processing time regarding humans on the one hand and electronic machines on the other, a difference in phase delay of signal transfer between technology and human physiology. But quasi-technological timing can be detected within human neuroprocessing itself, a kind of chrono-engineering. Pre-emptive activity is what apparently is stimulated in the pre-frontal cortex of the brain which does not simply react to incoming sensations but time-critically tends to anticipation (familiar from the difference between "live" and "real-time" signal transmission within communication media).

"The word *communication* will be used here in a very broad sense to include all the procedures by which one mind may affect another. This, of course, involves not only written and oral speech, but also music, the pictorial arts, the theatre, the ballet, and in fact all human behavior. In some connections it may be desirable to use a still broader definition of communication, namely, one which would include the procedures by means of which one mechanism (say automatic equipment to track an airplane and compute its probable future positions) affects another mechanism (say a guided missile chasing this airplane)."⁸⁰

A perceptual gap opens between the actual moment of the audio track and the visual frame in cinematography: introducing a loop which allows for the pre-cursive "reading" (by photo-cell) of the audio track on the film reel. Between the run-time of audio-through-air and visual emanation reflected from the screen opens a techno-traumatic micro-temporal gap (that is, induced by a technical asynchronicity).

TempoR(e)alities and "The Crannies of the Present" (Massumi)

The delayed present unfolds as a function between the technically mediated and the immediate. "Journalism" in the media-archaeological sense not only refers to the French *jour*, the day-to-day reports in the early Medieval Annalist tradition, but as well to the chrono-technical rhythm of the printing press.

79 Hertha Sturm, *Wahrnehmung und Fernsehen: Die fehlende Halbsekunde. Plädoyer für eine zuschauerfreundliche Mediendramaturgie*, in: *Media Perspektiven* 1/84, 58-65 (61)

80 Warren Weaver, *Recent Contributions to the Mathematical Theory of Communication*, in: Claude Shannon / same author, *The Mathematical Theory of Communication*, Urbana (University of Illinois Press) 1964, 1

According to Freud's definition, both affect and trauma break through the cognitive "Reizschutz" of symbolically ordered time which surrounds human perception. If taken literally, Freud's expression of the psychic "apparatus" corresponds with media in techno-logical resonance. From there derives the psycho-technological power of media - the techno-trauma. The potential of media is the technological real, resulting in specific forms and experiences of tempor(e)ality.

Even if "tele-vision" seems to indicate that the scopic regime is remote: perception from afar by definition, optical sensation itself is based on electro-magnetic waves which reach the human eye almost instantaneously. Human perception - even if watching a video recording - is always in the present, but in different audio-visual ways / waves. TV is always "in the now" (from the camera and broadcasting perspective); with online communication media, the receiver as well is always "on". Already TV "live" transmission (on the signal side) provided for synchronicity in time, a being-there-in-time (while not in space), in decisive difference to cinematography which is a storage medium, re-projecting an always delayed present - even with a striking difference in the *Zwischenfilmverfahren* of German TV on occasion of the Olympiad 1936 in Berlin.

A critical moment happened at the Riga documentary film festival in 2001 on September 11th, when after watching a film projection in the cinema theatre, the audience was led for a coffee break into the adjacent conference room. There a TV monitor showed the puzzling images of a collapsing World Trade Tower. In the TV live coverage, the electronic medium came "to itself" (in Hegelian terms). On that Tuesday, the looped CNN "breaking news" interrupted the filmic event - breaking the cinematic situation by the TV apparatus.

In analogy to the "optical unconscious" identified by Walter Benjamin in relation to the camera lense, there is the "temporal unconscious" as well. Time-critical analysis focuses on the *arché* of the signal event itself as incipient actions, known from electro-acoustic analysis of the transitional "attack" in striking a musical tone, or the flashing cinematographic image. Such a temporal event does not necessarily unfold in a chronological order. The integration of the past with the here-and-now of the present, and the immediate becoming-past of the present moment ("the infra-instant", according to Brian Massumi) are "differential aspects of the same integral enactment"⁸¹.

New "shapes of time"

81 As expressed by Brian Massumi, The Crannies of the Present, lecture at the Sawyer Seminar, Harvard University, end of April, 2014

On the scene of human culture, a new drama gets into focus: the technologically induced *chronopoetics* of microtemporal processes. Both in neuroscience and in studies of electronic and digital technologies, the analysis of time-critical action develops into an epistemology which radically challenges the traditionally familiar terms of emphatic time, with a shifting emphasis towards the non-linear, stepwise sequential, loop-folded, algo-"rhythmic" events. There is a privileged affinity between sonic tempor(e)alities and time-critical, "timely" media.⁸²

Electronic media tempor(e)alty: "acoustic space" (McLuhan)

Sonicity for the analog electronic media epoche has been identified by Marshall McLuhan. The wall painting created by René Cera, *Pied Pipers All* (1969), for McLuhan's seminar room at the university campus in Toronto⁸³, in a psychedelic manner unveils the television image as a sonic event. Whatever its apparent content, the tempo-real message of electronic media is "acoustic" in McLuhans sense of a different temporality: "[...] he argued that electronic media were submerging us in this acoustic environment, with its own language of affect and subjectivity. Acoustic space isn't limited to a world of music or sound"; the environment of electronic media itself engenders this way of organizing and perceiving chronospheres.⁸⁴

But the digitally modulated (PCM) electrosphere of today differs from this radiosonic (AM) metaphor. With digital numbers, central characteristics of what McLuhan diagnosed for the printing press age have returned, thus bracketing the age of analog electronic (mass) media as a interplay of modernity. In a dialectic synthesis, mobile digital telecommunication is now combined with the characteristics of "acoustic space" which is simultaneity. According to Marshall McLuhan's *Media Log*, "[s]imultaneity is related to telegraph, as the telegraph to math and physics."⁸⁵ But this discrete simultaneity is of a different kind. "Now, Internet 'radio' isn't radio; it does not exploit the spectrum, and that is a big difference"⁸⁶ - just like the difference between music recorded in vinyl grooves and its

82 The English adverb *timely* corresponds to German "rechtzeitig, zeitgemäß, fristgerecht, frühzeitig"; see

<http://www.dict.cc/englisch-deutsch/timely.html>, accessed September 8, 2014

83 See

<http://www.greatpast.utoronto.ca/GalleryOfImages/VirtualMuseumArtifacts/PiedPipers.asp>; accessed September 2nd, 2014

84 Erik Davis, *Acoustic Cyberspace*. Talk delivered at the Xchange conference, Riga, November 1997, <http://www.techgnosis.com/aco>. Published in: Rasa A mite / Raitis A mits (eds.), *Acoustic Space - net*. audio issue, Riga (E-LAB) 1998

85 Marshall McLuhan, *Counterblast*. 1954 Edition, published by transmediale.11 Berlin (in cooperation with Gingko Press) in 2011

86 Davis 1997

Compact Disc inscription. Close analysis reveals bit streams which allow for information theory, thereby: mathematical intelligence to control the event of electro-magnetic signal transmission. This happens in sublime manipulation on the micro-temporal level. Even if (according to the Sampling Theorem) human perception might not even notice the difference between a high definition analog television image and its digital equivalent, ontologically this image has transformed into a different time-object once the critical perspective of the "receiver" is not humans but technologies themselves.

The sonicistic sphere in McLuhan's sense is (almost) simultaneous instead of time-linear: "Acoustic space is capable of simultaneity, superimposition, and nonlinearity, but above all, it resonates. 'Resonance' can be seen as a form of causality, of course, but its causality is very different than that associated with visual space" (ibid.). Through resonance in a physical - not symbolically coded - system, micro-events can cause distant objects to communicate - close to time-tunneling and Tesla-like energy transfer.

Sound is not just mechanical attacks, vibrations to the ear or aesthetic pleasure for the brain (von Helmholtz) but addressing the human (pseudo-)sense of temporality. The true message of sound as event is processual time. The "tuning of the world" (Schafer 1977) is a *timing* of the world as well. What looks physical (acoustic) is temporal in its subliminal affect. If the "sonic environment" is extended to so-called Hertzian waves as well, electromagnetism turns out as sublime temporality in all ways.

The chrono-poetical specificity of such sonicistic articulation can not be captured and subsumed by the logocentrism of traditional narrative historiography. "Acoustic space", as emphasised by Marshall McLuhan, is of a different temporal nature: not linear, but synchronous or reverberating.⁸⁷ McLuhan once called it "echo land" - which brings us back to signal delay time and micro-temporal folding.

Acoustic echo implies delay, the very temporality induced by the medium as channel of signal transfer which once led Aristotle in his treatise *Peri psyches* to deal (media-)philosophically with the "Inbetween" (*to metaxy*) - no neo-logism as a term by Aristotle, rather a graphical neo-graphism by writing the adverb with a capital letter, thus turning it into a noun which (after its translation by medieval scholars) turned into the well-known *medium*.

87 Marshall McLuhan / Bruce Powers, *The Global Village. Transformations in World Life and Media in the 21st Century*, Oxford et al. (Oxford University Press) 1989

"PHOTOGRAPHY was the mechanization of the perspective painting and of the arrested eye", whereas "Telephone, gramophone, and RADIO are the mechanization of post-literate acoustic space"⁸⁸. Such sonic space is understood here as the epistemological existence of sound.

Notwithstanding his confusing electricity and electronics, McLuhan thereby made a crucial discovery about the intrinsically "acoustic" structure of electronic mediascapes. In a letter to P. F. Strawson, author of *Individuals. An Essay in Descriptive Metaphysics* (1959), McLuhan quotes from that work: "Sounds, of course, have temporal relations to each other ... but they have no intrinsic spatial characters."⁸⁹

The immediacy of electricity has been valued essential by McLuhan as the definite difference to the Gutenberg world of scriptural and printed information: "Visual man is the most extreme case of abstractionism because he has separated his visual faculty from the other senses [...]. [...] today it is threatened, not by any single factors such as television or radio, but by the electric speed of information movement in general. Electric speed is approximately the speed of light, and this constitutes an information environment that has basically an acoustic structure."⁹⁰

At the speed of light, information is simultaneous from all directions and this is the structure of the act of *hearing*, i. e. the *message* or effect of electric information is acoustic - even when it is perceived as an electronic image (as defined by the video artist Bill Viola in his essay "The Sound of One Line Scanning"⁹¹).

Very media-archaeologically, McLuhan's identification of the essence of electronic media as "acoustic structure" evidently refers to an epistemological ground, not to the acoustic figure (what ears can hear). This ground-breaking took place with the collapse of Euclidian space into Riemann spaces and culminates around 1900 with quantum physical notions (the para-sonic wave/particle dualism, up to the "superstring" theory of today) on the one side, and Henri Bergson's dynamic idea of matter as image in the sense of vibrating waves and frequencies.⁹² McLuhan's "acoustic space" is oscillating time and implicitly re-returns in Gilles Deleuze's "interval" philosophy. Less philosophically, it actually

88 McLuhan, "Five Sovereign Fingers Taxed the Breath" (1954), xxx

89 Dated April 17, 1969. Letters of Marshall McLuhan, selected and edited by Matie Molinaro / Corinne McLuhan / William Toye, Toronto / Oxford / New York (Oxford University Press) 1987, 367

90 Marshall McLuhan, letter to Barbara Ward, 9 February, 1973, published in: McLuhan 1987: 466

91 Bill Viola, The Sound of One Line Scanning, in: Dan Lander / Micah Lexier (eds.), Sound by Artists, Toronto / Banff (Art Metropole & Walter Phillips Gallery), 1990, 39-54

92 Henri Bergson, Matter and Memory, London (George Allen & Unwin) 1950, 276

happens within algo-rhythmic media.

In a media-archaeological sense, the message of the sonic is not limited to the audible at all, but a mode of revealing modalities of temporal processuality - which requires epistemological auscultation.

If phenomenology is not reduced to human sensation, perception and mind, it extends to a kind of phenomenology *of* and *by* the machine as made possible by signal sensors. It is the "sample&hold" mechanism which not simply translates but even transsubstantiates (to borrow a term from Catholic religious liturgy) the analog physical world into digital computability.

It is not just a further variance in the long history of philosophy of time but, in identifying concrete techno-logical scenarios that media archaeology analyses new "shapes of time" (George Kubler) - by reading circuit diagrams instead of knowledge historiography only. The sample-and-hold mechanism performs *the ephemeral archive* - with its records being "stored" only for a fraction of a millisecond. Condensers as among the smallest electro-physical storage elements, combined with transistors, function as micro-archives here. The electronic bit - other than most people think it - is a temporal being in such electronic circuits, not punctual, but a suspended instant of time (as voltage)

The media-archaeological approach still shares a core cybernetic assumption (cybernetics is not historicized here as a chapter in the history of knowledge, but still burns in the hearts of media archaeologists): From the *coupling* of humans to techno(chrono)logical beings (artefacts), a specific experience of time results.

By elaborate chrono-techniques, the question of "temporality" is decoupled from history as a specific concept of narratively organizing temporal sequences. Once chrono-analysis is suspended from the historical discourse, a more radical challenge arises: Is it possible to deal with micro-temporalities without mentioning the transcendent signifier "time" at all - in favour of a multitude of descriptive terms, a "field"? "Time - today [...] - seems to reveal a new structure and to unfold in a rhythm that is different from the 'historical' time that governed the nineteenth- and the early-twentieth centuries. In this new chronotope - for which no name exists yet, even though we live within its forms - agency, certainty, and the historical progress [...] have faded into distant memory."⁹³

["Just as linear history begins with writing, it ends with TV"⁹⁴, McLuhan radically declared in a post-Hegelian mode. History depended on a

⁹³ Hans Ulrich Gumbrecht, *After 1945. Latency as Origin of the Present*, Stanford, Cal. (Stanford University Press), 38

cultural technique which is alphabetic, linear writing. The "writing" of images and texts on the cathode ray tube for television and computer monitors is of a different kind. Electronic media, therefore, are not just another variance in the history of technology but establish a new kind of temporal reality which escapes the concept of history.]

In contemporary society where the grand symbolical horizon and panoramic (pan-chronic) bird-eye view of temporal extension (religious eternity, the epochs and philosophy of history) has been condensed into (or even replaced by) ever shrinking temporal intervals and a focus on condensed present, the close analysis of decisive temporal actions reveals the drama of time-critical media.

The public TV channels in Germany legally are obliged to provide the possibility for users of streaming media online access to a selection of broadcasts stored for a week. What techno-cultural timing unfolds is an extended present, differentiated by a *media dramaturgy* of minimal or even micro-times.

The "acoustic" structure of electronic media

As a counterblast to the so-called "visual turn" or "pictorial turn" declared by W. T. Mitchell long ago, recent years proclaim another rebellion against the Gutenberg galaxy, which is the "sonic" or "acoustic turn", accompanied by new methods of making information and even knowledge accessible over the so long neglected acoustic channel of perception (audio interfaces, methods of sonification of data to the time-sensitive ear). It has been McLuhan who anticipated this turn already, a theorem bound to his analysis of the electronic age which he sharply discontinues from the machinic age.

Notwithstanding his confusing of electricity and electronics, McLuhan made a crucial discovery. In a letter to P. F. Strawson, author of *Individuals. An Essay in Descriptive Metaphysics* (1959), McLuhan quotes from that work: "Sounds, of course, have temporal relations to each other ... but they have no intrinsic spatial characters."⁹⁵ The immediacy of electricity has been valued essential by McLuhan as the definite difference to the Gutenberg world of scriptural and printed information: "Visual man is the most extreme case of abstractionism because he has separated his visual faculty from the other senses [...]. [...] today it is threatened, not by any single factors such as television or radio, but by the electric speed of information movement in general. Electric speed is

94 Marshall McLuhan, *Counterblast*, New York (Harcourt, Brace & World) 1969, 122, as quoted in Bexte 2008: 332

95 Dated April 17, 1969. *Letters of Marshall McLuhan*, selected and edited by Matie Molinaro / Corinne McLuhan / William Toye, Toronto / Oxford / New York (Oxford University Press) 1987, 367

approximately the speed of light, and this constitutes an information environment that has basically an acoustic *structure*."⁹⁶

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In an epistemological sense, the sonic is not about (or limited to) the audible at all, but a mode of revealing modalities of temporal processuality. At the speed of light, information is simultaneous from all directions and this is the structure of the act of *hearing*, i. e. the *message* or effect of electric information is "acoustic" - even when it is perceived as an electronic image, as defined by the video artist Bill Viola in his essay "The Sound of One Line Scanning".⁹⁷

"Liquefying" the archive

David Lynch's film *Inland Empire* which begins with the image of a spinning record on a record player. "As the needle drifts across the timeless surface of reified sounds, we are, once again, in the realm of mechanical reproduction and the logic of industrial time."⁹⁸

Henri Bergson's criticized the mechanical (escapement-driven) clock measurement of time as mathematization which is spatialisation instead of temporal duration. Technical juxtapositions, interjections, cuts and ruptures result in the loss of the chronology and directionality of time. "[T]he digital fragmentation of time is terrifyingly opaque and illegible for the human subject."⁹⁹ Such a technological sublime leads to a sublime micro-tempor(e)ality.

With the present interpreted as a function of memory operations (both neurologically and digitally), the transformation of the traditional *tempaurality* of archival storage needs to be observed. From archival space to archival time, the archival "field" gets into focus. Dynamic

96 Letter to Barbara Ward, 9 February, 1973, in: McLuhan 1987: 466

97 Bill Viola, The Sound of One Line Scanning, in: Dan Lander / Micah Lexier (eds), *Sound by Artists*, Toronto / Banff (Art Metropole & Walter Phillips Gallery), 1990, 39-54

98 Zoltán Glück, *After Midnight, or: The Digital Logic of Time Fragmentation in Inland Empire*, in: *Munitionsfabrik 19* (2008), HfG Karlsruhe, 8-11

99 Glück 2008: 9

micro-media memories induce a cultural shift of emphasis from permanent storage to restless transfer. With the aesthetics of re:load, the affinity between the archival operation and cybernetics turns out, resulting in feedback memory and timeshifting. Once these transformations have been analyzed, the topic "suspended memory *versus* total recall" results in a plea for the *secret archive* again.

There are good reasons for questioning the static concept of an "archive" as appropriate term for digital record structures since as a metaphor it is increasingly becoming a hindrance for the analysis of dynamic data storage and circulation. The computer hard disc *moves* stored data in post-structural ways, just like the gramophone record and the magnetic tape did with recorded electronic signals (sound and / or video) before.¹⁰⁰

Not yet memory? Focus on storage tempor(e)alities

The volatility of data stored in SRAM or DRAM makes all the media-epistemic difference.

According to Husserl, time is a stream of experiences with an infinite chain of *now*-points which are temporal impressions, each of them embedded in a time-sphere of retention (a now-point just passed) and a protention - "an expectation of a now-point which is still in the future but which becomes a now-point in the present"¹⁰¹. This rather time-critically counts for acoustic (the mechanical vibrational touch) and haptic sensation especially.

There is micro-memory involved in the sonic perception of presence already; the present is by no means experienced as punctual "now". On the micro-acoustic level this re- and protention has been discussed to explain melody experience by Edmund Husserl¹⁰² and Henri Bergson and fits into what neuro-science calls the time-window of "presence" as perceived within humans: about three seconds of duration.

Micro-archiving the present: intermediary storage, delay lines

100 On the archive becoming *processual* in digital algorithms, in accordance with Alfred North Whitehead's philosophy of the dynamic event (*Process and Reality*, New York 1929), see Barker 2012

101 As paraphrased by K. R. Eissler, *The Psychiatrist and the Dying Patient*, New York (Intenrational University Pres) 1955, 272, quoted here after Hartocollis 1983: 4

102 "Jeder Ton hat selbst eine zeitliche Extension, beim Anschlagen höre ich ihn als jetzt, beim Forttönen hat er aber ein bereits neues Jetzt, und das jeweils vorausgehende wandelt sich in ein Vergangenes": Edmund Husserl, *Vorlesungen zur Phänomenologie des inneren Zeitbewußtseins* (ed. Martin Heidegger [*1928], 2nd ed. Tübingen (Niemeyer) 1980, 324

Electro-mechanic transmission of photographic images *via* telegraph cables in 19th century was performed via intermediary storage, the "digital" data carrier of punched cards. Even if at first glance, rather complicated, it relieved communication engineering from the delicate time-critical synchronisation problem between sender and receiver.¹⁰³

"In the convergence between a repetition and a renewal lies the tendency to archive while bringing forward: past and present instantly simultaneous in the fragmented image. While it loops the past, the digital creates an image of an archival strategy where time passed becomes constantly accessible for the future. [...] reality's duration seems to have become a continuous stream of information potentially open for another time."¹⁰⁴

Between the archive and the anarchive there is temporary storage. Proper archives essentially aim towards long-term, if not even the unlimited preservation of their documents and today`s media archivists grapple desperately with the problems of technological obsolescence; the temporalisation of archives therefore is an anarchival element in the economy of cultural tradition. New concepts like *The Archive in Motion* (Rossaak 2010) and `temporary archives` are symptoms of this temporalisation of the archive. The immediateness of the retrieval of immense volumes of data through online databases contends with an increasingly short-term maximum usability period, which contemporary culture knowingly accepts. Yet this temporalisation of the symbolic order is predetermined at the operative level of the present itself, namely in the practice of signal and data transmission. Delay lines served the micro-synchronisation of PAL colour television signals as well as the short-term maintenance of data words in the first electronic computers. It belongs to the nature of so-called new media that they compute by shifting voltage levels interpreted as binary states, constantly accumulating interim values and then deleting them again. The mathematisation of technical communication by Shannon results in a transmission channel which consists of discrete temporary storage – an unexpected return of the familiar archival or yet critically radicalised. The vocabulary of classic archivology fails when faced with such micro-temporal modes of technological action.

"Time of non-reality": *Totzeit*, negative time

103 Christian Kassung / Franz Pichler, Die Übertragung von Bildern in die Ferne, in: Albert Kümmel-Schnur / Christian Kassung (eds.), Bildtelegraphie. Eine Mediengeschichte in Patenten (1840-1930), Bielefeld (transcript) 2012, 101-121 (110)

104 Markos Hadjioannou, From Light to Byte. Toward an Ethics of Digital Cinema, Minneapolis (Univ. of Minnesota Pr.) 2012, 174

Not only do electronic systems tend from perceptible timing operations to subliminal micro-temporal operations (like the in- or rather de-creasing clocking and cycling units in digital computing); a new quality emerges with "binary" information theory: Norbert Wiener's notion of "time of non-reality" which is negative time which does not "count" in binary counting (computing) - real switching moments (*hysteresis*).

There are in fact different classes of the temporal *inbetween*: the Dirac-impulse (the momentary interruption - approaching the ideal time-criticality of the "real") and the temporal moment evolving inbetween switching or flipping binary alternate states. Such a "time of non-reality" (Norbert Wiener)¹⁰⁵ only counts when the speed of calculation approaches the real-time window of presence. For re-presenting the past, an empty signifier is required. But how to represent a void without turning it immediately, and by the very process of signification, into a presentation, i. e. a mark of presence? Mathematically, the cipher (literally *zero*) is to fulfill this function; on the typewriter keyboard, it is the key for *blanc* which performs this (which, in digital terms, is nothing but a - positive - bit as well, indifferent to other ciphers or letters or ASCII signs). Maybe the only way out is to quit the semiotic realm, not musing about signs any more, but reconsidering signs as signals, i. e. as very physical impulses - the very flow and energy of the Internet (as) information. Neither the local inbetween - the *spatium* - nor the arithmetic symbol "zero" is simply nothing; suspension (German / Hegelian "Aufhebung") is the temporal correlate to these terms.

The micro-temporal *camouflage*: High Frequency Trading

Within virtual data event-fields like the digital Stock Exchange, time-critical temporalities become economical *temporealities*. High frequency trading operates with time-"hiding" purposes which had been tested in perceptual experiments in the 1960s: smuggling ultra-short moments of Coca Cola advertising into a regular TV movie, not consciously noticed by the viewer). This brings us back to the cinematographic affect.

A certain *irritation* of presence by the technical manipulation of optical human perception of movement is based, among other criteria, on the physiological phenomenon of irradiation. This refers to the core procedure of kine-mechanics - not in its sense of creating an illusion of figurative movement, but as sensational (optical) physiology.

In the conventional view, for understanding economic and financial markets, long-term trends (diagrammatic time lines) have to be

¹⁰⁵ See Claus Pias, Time of Non-Reality. Miszellen zum Thema Zeit und Auflösung, in: Axel Volmar (ed.), Zeitkritische Medien, Berlin (Kulturverlag Kadmos) 2009, 267-279

examined. Now that such events happen on the scale of seconds and time-fractions below, analysis has to approach such signals in terms of communication engineering and mathematical stochastics *like* (or even *as*) noise, that is: statistically insignificant. In the runup to the 2008-2009 financial crisis, a concentration of miniature flash crashes occurred in banking stocks: "[I]t suggests a link between what goes on at a sub-second level and what happens on the scale of months. At that point it started to look like an ecological system. Because [...] you have predators of all sizes [...]. The algorithms are all looking for and picking up some kind of weakness in those particular bank stocks [...]" - not actually causing the crash, "but they were like sensors of the impending bigger weakness".¹⁰⁶

Such time-critical algorithms are time-beasts. The focus of Delta- t analysis shifts from macro-temporal economical cycles to micro-temporal intervals.

Interplay: Gaming with the Pin Ball machine

The human hand is time-critically coupled in the cybernetic sense in the case of the Pin Ball machine, as described in a typescript entitled "Flipper" by Friedrich Kittler from the late 1960s or early 70s which immediately anticipates the first generation of computer games. If a human being is defined by his gaming instinct, he becomes inhuman once his partner is an automaton. This counts for the temporal aspect of gaming as well. The human pinball player with his hand(s) as interface to the automaton has to critically adopt to the electric tempor(e)ality of the machine.¹⁰⁷

When discretely (not analogically / diagrammatically) calculating either in his mind on square paper with a pencil and erasing head, man is in (Turing-)Machine state.

The challenge of anti-aircraft prediction in World War II from the point of view of the artillery, as confronted by Norbert Wiener - gave rise to *Cybernetics* itself (Wiener 1948, Introduction) - and by Claude Shannon in a different approach separating the physical laws of the machine (airplane) from the idiosyncratic (counter-)reactions of the human pilot.

The human "Flipper" game player with his hand(s) as interface to the automaton has to adopt to the tempor(e)ality of the machine; Kittler

¹⁰⁶ Andrew Smith, Fast money: the battle against the high frequency traders, in The Guardian, 7th June, 2014;

<http://www.theguardian.com/business/2014/jun/07/inside-murky-world-high-frequency-trading>, accessed 15th July, 2014

¹⁰⁷ In: Friedrich Kittler, Baggersee. Frühe Schriften aus dem Nachlass, edited by Tania Hron / Sandrina Khaled, Paderborn (Fink) 2015, 58 f.

inserts a Latin quote. The equivalent to tactics in the temporal field of such cybernetic human-machine couplings is time-criticality.

Cybernetics has replaced the notion of the present moment as *stasis* by the insight into "Circular Causal and Feedback Mechanisms in Biological and Social Systems"¹⁰⁸.

Human cultural behaviour is bound into the symbolic regime - be it traffic lights inducing their binary stop-and-go, or the symbolic clocking of 24 hours a day. Still, in an individual experience a whole world of variances and delays unfolds between. On the even more subliminal level of temporal perception, "different stimuli which are processed within a *temporal window* of approximately 30 ms are treated as *co-temporal*, i. e., a temporal relationship with respect to the before-after dimension cannot be established for such stimuli. Information gathered within a temporal window of 30 ms is treated as *a-temporal*, i. e., there is no temporal continuity defined and definable for stimuli that follow each other within such intervals."¹⁰⁹ There is a tempor(e)al sublimity of "digital media", underscoring human perception in favour of an apparent continuity of time, but still being *sublimely* time-discrete.

Micro-archiving presence from analog to digital technologies: functional sounding

As long as it is not supplemented (or merged) with an optical perception, the perception of a bodyless voice from the past from a recording leads to an essential lack of the sense of origin.

The most common notion of "historical" time is based on an external observation, drawing of a distinction (in Spencer-Brown's terms¹¹⁰) between past and the present. In digital computing, this distinction has collapsed technologically into the most minute, i. e. binary micro-temporal *différance* (in Jacques Derrida's neo-graphism), as has been applied e. g. in the ENIAC computer: "[W]e feel strongly in favor of the binary system for our [sc. "memory"] devices. Our fundamental unit of memory is naturally adapted to the binary system since we do not attempt to measure gradations of charge at a particular point in the

108 The original title of the so-called Macy-Conferences in New York, ed. by Heinz von Foerster 1949, and subsequently by v. Foerster / Mead / Teuber 1950, 1951, 1953, 1955

109 Ernst Pöppel, Reconstruction of Subjective Time on the Basis of Hierarchically Organized Processing Systems. Lecture given at the conference: Time, Temporality and Now, Max-Planck-Gesellschaft, Schloß Ringsberg (at Tegernsee), February 1996, quoted here after Klose 2002: 359

110 George Spencer-Brown, Laws of Form, Portland, Ore. 1994

Selectron [sc. cathode ray tube] but are content to distinguish two states"¹¹¹ - which makes all the difference to analog computing.

The electro-magnet relay and later the flip-flop materially provided for such a truly binary device. "On magnetic wires or tapes and in acoustic delay line memories one is also content to recognize the presence or absence of a pulse of (if a carrier frequency is used) of a pulse train."¹¹² This leads to the time-functional use of sound which is *sonicity*.

Technical recording of sound itself is a process of storage. "The breaking of the time constraint has profoundly changed the nature of acoustic communication."¹¹³ The temporality (and volatile being-to-death) of sonic articulation which hitherto could only be recorded symbolically by mnemonic notation is transformed into space and visualization by the very act of recording, making it available for analysis "outside of time" <ibid.>. The temporal essence of sound is thereby turned into a reified, objectified time object, from evanescence to the literally ob-scene.

The traditional sound record - like the textual record - can be included within an institutional archival frame. With digital sound, though, literally every bit of sonic articulation becomes part of a generalized "archival presence", since a) every digital signal processing involves ultra-short quasi-archival intermediary storage and b) every sound "bit" becomes numerically addressable and thereby accessible to mathematical / algorithmic manipulation. The archival frame is deconstructed and returns from within the digital archival records themselves. From analog to digital "archiving" of sonic presence, "the manner of storage determines the kind of control that can be exercised over it" - from manipulation to distortion.¹¹⁴ At the same time, the analog-to-digital conversion results in a transsubstantiation of the audio signal: from the primary physical event to information which is essentially neither energy nor matter. Thereby the signal loses its time-indexical trace¹¹⁵; transitive wave forms become numerical, geometricised time. Electro-magnetic sound transduction must therefore to be set into quotation marks: "[...] the digital 'transduction' process includes the digitalization of the analog signal by the ADC, its <micro->storage and / or manipulation in binary number format, and its reconstruction as an analog signal by the DAC"¹¹⁶ - which is the conversion of an electronic embodiment of a number representation

¹¹¹ Section 5.2., in: Arthur W. Burks / Herman H. Goldstine / John von Neumann, Preliminary Discussion of the Logical Design of an Electronic Computing Instrument, in: John von Neumann, Collected Works, vol. 5, ed. by A. H. Taub, Oxford (Pergamon Press) 1961, 34-79; reprint in: Swartzlander (Hg.) 1976, 221-xxx (227)

¹¹² Burks et al. 1961 / 1976: 227

¹¹³ Barry Truax, Acoustic Communication, Norwood, N. J. (Ablex) 1984, 117

¹¹⁴ Truax 1984: 119

¹¹⁵ See Laura Marks 2002

¹¹⁶ Truax 1984: 139

stored in the computer memory to discrete voltage steps at fixed time intervals (Dt). The physically continuous original waves are thus transformed into square waves; in fact every binary computational act is an abrupt form of oscillation between zero and one in a time-sequential form. Only by smoothing the square wave by filters the wave becomes continuous again.

A kind of micro-archiving of presence is conceptually and technologically implied in the real-time processing of signals, since as a digital time-discrete sampling and quantizing of moments from the present signal (punctualising the continuous signal event) it requires intermediary short-time storage of data. The concept of real-time and "interrupt" for user input in computing dislocates the metaphysics of pure presence to micro-deferred presence.

The present signal event and its immediate storage merge into one with the increasing digital, i. e. intermediary recording of present spaces. Space itself is being transformed into time-coded snapshots by increasing instant photography from the I-pad and other mobile devices which step by step ("one bit at a time") *sample* presence (sampling in both technological and meso-temporal meaning). Space becomes re-windable¹¹⁷, just as it is indicated in the notion of *tx-transform* as technology of time axis manipulation.¹¹⁸

Media-induced shock more general

The traumatic implosion of an electronic image (as in the case of the last transmission a public speech by Ceaucescu in Rumania December 1989) is of a different kind than the disruption of a celluloid film. Recently, the momentary break-down of Greek state radio and TV broadcasting by a sudden government decision for budget shortages resulted in a technologically induced shock: "It is quite an experience as Silence and Black reigns on public Greek media. In TV it was much more dramatic because the closure had already been announced and there were theatrical countdown moments when the frequency was shut down."¹¹⁹ Indeed, the visual shock of abruptly finishing broadcast is of a different kind than the acoustic experience.

"Shock" with Benjamin

117 Alexander Galloway / Eugene Thacker, *The Exploit. A Theory of Networks*, Minneapolis 2007, 132

118 *tx-transform* is the title of a short film produced by Martin Reinhart with Virgil Widrich (35 mm, Austria 1998)

119 E-mail communication by Konstantinos Vassiliou on August 13, 2013

Human perception is shaped by the variant media conditions. In a way close to what Marshall McLuhan later termed "the medium is the message", Walter Benjamin interprets film not in its content but rather as a setting just like a physiological experimental laboratory. The dramaturgy of "choque" accommodates the audience on the perceptual level to the speed of modernity and time-critical moments. What escapes the imaginary (the cinematographic screen and its illusion of flowing movement), is subliminally perceived as a fragmented series of 24 frames per second, involving a permanent affective / cognitive dissonance on the non-discursive level already..

Walter Benjamin coined the term "physische Chokwirkung" for the cinematographical image.¹²⁰ Different from the photographic *punctum* (Barthes), the traumatic moment in the filmic image is its temporal movement- thus closer to the phonographic voice. Whereas an image can be motionless endurance, a recorded sound can not but dynamically unfold - between the temporal now ("the present") and auratic appearance ("presence" and "re-presencing").

In his notorious essay on "The Work of Art in the Age of Reproduction" (1936) Walter Benjamin identifies a loss of aesthetic "aura" which is bound to tradition and the uniqueness of the work of art in space and time by means of technical reproduction (mainly photography, but as well phonography, influential up to Baudrillard's notion of simulation. Furthermore, Benjamin sees human perception shaped by the variant historic media conditions. In a way close to what Marshall McLuhan later termed "the medium is the message" he interprets film not in its content but rather as a setting just like a physiological experimental laboratory, when stating that the audience is subjected by the apparatus into a psycho-laboratory *test* situation.¹²¹ The dramaturgy of "choque" accommodates the audience on the perceptual level to the speed of modernity and time-critical moments, as expressed in Ernst Jünger's writings on photography.

The anachronistic momentum of technological recording

Woody Allen's film *Zeelig* operates with digitally interpolated past as fictitious testimony. Unlike the Barthean "punctum" in photography, the anachronism is not imbedded in the recording itself any more.

120 Walter Benjamin, Das Kunstwerk im Zeitalter seiner technischen Reproduzierbarkeit, in: same author, Illuminationen, ed. S. Unseld, Frankfurt/ M. (Suhrkamp) 1969, 148-184 (172)

121 "Das Publikum fühlt sich in den Darsteller nur ein, indem es sich in den Apparat einfühlt. Es übernimmt also dessen Haltung: es testet." Walter Benjamin, Das Kunstwerk im Zeitalter seiner technische Reproduzierbarkeit [*1936], Frankfurt/M. (Suhrkamp) 1963, 26

The time-critical moments of *mémoire involontaire* in Marcel Proust's *A la recherche du temps perdu* which look contingent can be neuro- and media-archaeologically "grounded". The reanimation of phonographically un-dead sound recordings falls short from the theological notion of redemption; so let us not be trapped to follow a hidden "messianic" eschatology masked by so-called media archaeology. With any re-play of an old phonographic recording of Caruso's voice, history-defying short circuits presuppose that the mechanical and electromagnetic rules known to the designers of sound recording devices are still in operation today. Indeed, the phonographic record allows for time axis manipulation against the physical and cognitive law of the irreversibility of history. "New media, as vehicles that carry our senses and bodies across the space-time continuum, introduce to us old modes of experience [...]. Media thus bear the messianic power, in Benjamin's special sense of that word, to forever alter the past."¹²²

The Edison phonograph did not arise from desire for a memory medium. In fact it rather unintentionally resulted from Edison's experiments in speeding up transmission of telegraphic signals, recording the Morse code dots and dashes on an intermediary storage device (the embossy telegraph with rotating discs) for accelerated transmission: "[...] to make a repeater that would store words without the labor of the human hand [...]"¹²³ - just like the draughtsman Henry Fox Talbot developed photography from his wish for images from nature to be liberated from the inaccuracies of his painterly hand.

If for this reanimation of dead sounds and images the word "redemption" might be applied, this is not simply a reference to Walter Benjamin's "messianic" historical materialism; we might phrase it rather the other way round: Benjamin's phrasing is now itself redeemed by technical media of suspended time.

Signal "immediacy": dissimulated presence

"Presence" expresses a subjective perception of non-technicity in media participation, well known from traditional rhetoric as the figure of hiding the awareness of artificial speech configuration *dissimulatio artis*. When a voice from phonographic record is being re-played, both the technicity of the apparatus and the historicity of the actual recording are being forgotten in favour of the physiological a/effect of presence. Bolter & Grusin, developing on McLuhan's *Understanding Media*, describe such

¹²² John Durham Peters, Helmholtz, Edison, and Sound History, in: Lauren Rabinovitz / Abraham Geil (eds.), *Memory Bytes. History, Technology, and Digital Culture*, Durham / London (Duke University Press) 2004, 177-198 (195)

¹²³ Peters 2004: 188

immediacy for the realm of visual representation "whose goal is to make the viewer forget the presence of the medium (canvas, photographic film, cinema) and believe that he is in presence of the objects of representation"¹²⁴ - whereas *hypermediacy* actually emphasizes the presence of the medium and does not dissimulate it in favour of the impression of using a previous (familiar) one - just like modernist painting, according to Clement Greenberg, is defined by making the material medium itself the aesthetic message.¹²⁵

"POSTING" DIGITAL PRESENCE: A MICRO-TEMPORAL REGIME

"Post-digital" media culture? Sustaining a critical philosophy of algorithmically driven technologies

The expression "from analogue to post-digital", like any "postism", already suggests a *temporal* vector, a linear, almost teleological evolution. In a genuinely media-archaeological critique of such chronologic historicism, computer-based culture gets progressively used to non-linear figures of tempor(e)ality, as known from computer programming itself: the "GO TO" jump order in algorithmic source code, and other figures like iteration, loop, and recursion.

It is this "post-digital" tempor(e)ality which deserves close analysis. The micro-temporal features of the "post-digital" condition result in almost imperceptible, fundamental irritations of the sense of the present. The technical core of such operations of sampling the visual present is the sample-and-hold mechanism for converting analog signals into digital bits. This invites for a revision of the perceptual impression of visual movement from chrono-photographic reproduction. Human perception of the "present" is affected by sublime micro-technological zones of indeterminacy between the analog and the digital, especially in its sonic emanations.

The historicism suggested by the adverbial trajectory *from* analogue *to* the post-digital is seductive. In many media-archaeological respects, the digital image has preceded the analogue one, like Alexander Bain's telegraphic image transfer already in early 19th century.

The "Editorial" of the Post-digital Research journal APRJA provides a working definition of the *post-digital*: "Post-digital, once understood as a critical reflection of 'digital' aesthetic immaterialism, now describes the messy and paradoxical condition of art and media after digital

124 Jay David Bolter / Richard Grusin, *Remediation. Understanding New Media*, Cambridge, Mass. / London (MIT Press) 1999 2000, 272 f.

125 Clement Greenberg, *Toward a Newer Laocoon* [1940], in: idem, *The Collected Essays and Criticism*, vol. 1: Perceptions and Judgments, 1939–1944, Chicago / London 1986, 23-38

technology revolutions. 'Post-digital' neither recognizes the distinction between 'old' and 'new' media, nor ideological affirmation of the one or the other. It merges 'old' and 'new', often applying network cultural experimentation to analog technologies which it re-investigates and re-uses. It tends to focus on the experimental rather than the conceptual¹²⁶ - which nowadays results in an explosion of emergent "labs" in digital humanities.

The current discussions on the "post-digital" remind of the former debates on the "post-modern". Against the post-isms, Jean-François Lyotard, in *The Postmodern Condition*, rather defines the "post" as enhancement, not as "beyond". If in that sense "postmodernity" did not represent a new age, but rather repeated essential features of modernity¹²⁷, let us rather re-think the "digital" than dismiss it too early. It takes time to confront the challenge of the digital epistemologically. The fact that in ubiquitous computing the digital seems to have become part of everyday culture - just like listening to music from an MP3-Player introduced complex compression algorithms into popular culture - does not mean that contemporary culture has already digested the shock of digital electronics invading the analog world.

It is almost a "law of media" (Marshall McLuhan) that when the experimental, initial era of a "new medium" (where it is still consciously media-archaeologically experienced and reflected by the users) is transformed into a mass medium, the techno-logical message of the medium recedes behind its semantic and cultural "content". After "the digital" has been culturally ingested and become an everyday commodity with ubiquitous computing, culture is not yet "post-digital" but - in analogy to traditional radio and television - in a "mass-digital media" age. The digital, though, still needs to be media-theoretically and epistemologically to be "ingested" (Freudean *Durcharbeiten*) - which requires hard-edged techno-mathematical analysis of processual algorithms (radical media archaeology). The focus of my argument is therefore *not* on the term "post-digital" how it is used in the discourse of digital artistic practice which serves as a kind of tranquillizer for humanities: "It points to an attitude that is more concerned with being human, than with being digital."¹²⁸

McLuhan's posthumously published manuscripts on media time under the title *Laws of Media* are a kind of a media theoretical equivalent to Hayden White's seminal *Metahistory*. According to McLuhan, there is a

126 Issue 3.1 (2014) on *Postdigital Research*; www.aprja.net

127 Anne Elisabeth Sejten, Exhibiting and Thinking: An Anamnesis of the Postmodern, in: Yuk Hui / Andreas Broeckmann (eds.), *30 Years after Les Immatériaux*. Art, Science, Theory, Lüneburg (meson press) 2015, 159-178 (168)

128 <http://en.wikipedia.org/wiki/Postdigital>; accessed May 11, 2015

chrono-logical (not simply annalistic) figure of how technical media unfold in cultural time indeed: First - in its media-archaeological incubation - the new technology (such as cinematography or video, or the phonograph whose material presence receded behind the loud-speaker) itself is subject of attention and avantgardist experimentation; after a time of cultural accommodation it becomes a simple commodity and the focus shifts from the medium's message to ubiquitous content.

Significantly, one of the uses of the term "post-digital" developed in the sonic context. Kim Cascone coined and uses the term in his article "The Aesthetics of Failure: 'Post-digital' Tendencies in Contemporary Computer Music"¹²⁹; this referred to the glitch, to circuit bending, to "media archaeological" research art.

Nicholas Negroponte declared "The digital revolution is over" at MIT Media Lab in 1998.¹³⁰ In his version of the "post-digital", Cascone directly referred to Negroponte's manifesto in his analysis that "the revolutionary period of the digital information age has surely passed"¹³¹. Indeed, when the media-archaeological incubation phase is over (experimenting and experiencing a technological invention), the technical *a priori* becomes a black box in favour of aesthetic interfaces.

But inbetween is techno-logical formats and "apps". Here not the complex medium apparatus as such is the message like with radio and television before; rather, their specific electronic affordances and software tools themselves have become the *sub-mediatic* message. It is tools such as Max, SMS, AudioSculpt, Pure Data, and other that make possible "post-digital" music" (Cascone) which is characterized by micro-sonic, almost DNA-like operations.

As has been demonstrated by Martin Heidegger with the human use of the hammer as tool already, it is only from the failure (and noise) of a technology that the medium articulates itself.

["[G]litches, bugs, application errors, system crashes, clipping, aliasing, distortion, quantization noise, and even the noise floor of computer sound cards are the raw materials composers seek to incorporate into their music."¹³² Jem Finer defined the term *post digital*, in relation to his own artistic work, as "a return to a tactile relationship with ideas and materials informed by over 30 years of working with computers. A practice that seeks to transcend mediation via a screen and locate itself in the physical world, rather than at one stage removed, through digital

129 See http://subsol.c3.hu/subsol_2/contributors3/casconetext.html, accessed May 12, 2015; originally published in: Computer Music Journal 24:4 (2002)

130 Nicholas Negroponte's seminal essay "Beyond Digital, in: Wired 6 (12), 1998; <http://www.wired.com/wired/archive/6.12/negroponte.html>

131 Cascone 2002

132 Cascone op. cit.

representation". He first formulated the term in relation to his 1000-year-long musical composition, *Longplayer*¹³³. But there is more involved than just a nostalgia for the haptic dimension in analogue media interfaces; this "retro"-mania is rather an epistemological symptom, the longing for re-gaining a sense of temporality which has lost in high-frequency media culture operations.]

In a couple of other new media art works as well, the "post-digital" primarily refers to the re-entry of the physical existence and that into "the abstractness of the digital world" (ibid.). But then, is it only the hardware-oblivion of most digital media users and theorists which leads to this recent discovery that even the most immaterial and virtual mediascapes radically (that is: on the media-archaeological level) ground in ultimately analog electro-physics. The "bit" has always been (and still is) nothing but an extreme articulation of the continuous - from the conceptual "digital" back to the analogue.

The sublime presence of ubiquitous computing

In his book *The Computer for the 21. Century* (1991), Marc Weiser predicted ubiquitous computing: "Specialized elements of hardware and software, connected by wires, radio waves and infrared, will be so ubiquitous that no one will notice their presence."¹³⁴ Digital media transform into a *sublime* presence - sublime in Edmund Burke's and Immanuel Kant's sense of something which is there but can not be figuratively imagined by humans.

This reads like a counter-historical recursion of the first "digital" writing system in culture: the vocal alphabet, which in the first generation had been subject of media-critical attention (Platon, *Phaidros*), but then became culturaleal everyday practice, so that writing and reading hermeneutically shifted from the awareness of signifiers to a focus on semantic content.

All the more the media-archaeological veto is required, a kind of *katechon* ("beholder") as defined in the 2nd epistle of apostle Paul to the city of Thessalonike: The task is to defer public oblivion of the techno-mathematical conditions for articulations in so-called digital culture.

The re-entry of the "analogue" in the "post-digital"

133 As quoted in: <http://en.wikipedia.org/wiki/Postdigital>; accessed May 11, 2015

134 http://wiki.daimi.au.dk/pca_files/weiser-orig.pdf, as quoted in: <http://de.wikipedia.org>, entry "Postdigital", accessed May 11th, 2015

The discourse of the "post-digital" is useful when it helps to get rid of the simplistic use of the adjective "digital" which is confused with binary computing - whereas "digital" cultural techniques are as old as culture itself (counting with fingers, vocal alphabet, Morse code).

The "digital" has been at work already in alphabetic writing and the cinematographic frame sequence. The "analogue" media came inbetween: photography, phonography, electro-magnetic broadcast media (radio, television). With computing, the digital returns; in techno-mathematical terms, the numerical ("digital") signal analysis in the frequency domain is the inverse value ("Kehrwert") of the analogue wave form in the time domain.

Media-temporal loops happen in insular modes, different from media-historical emplotment of technological evolution. The alphabetic code corresponds with telegraphy, against which telephony (analogue signal transmission by electric transduction of the human voice) intervenes. But with "voice over IP", even telephony returns as digital communication.

Terms like the "post-digital" still fall victim to the symbolical time regime of historical discourse. Each *postism* affirms the narrative plot that technologies are being invented, they emerge, they flourish, they end, to be succeeded by another technical dispositive.

The term "post-digital" is meant to express that media culture has entered a stage where the digital as such is not an object of newness and excitement any more since in everyday life, in academic practice and in media art it has become common to work interactively. I still insist that the digital challenge, even if practically "ingested", has not yet been epistemologically and critically digested and needs ongoing media-archaeological distancing reflection.

We might be "post-digital" in the sense of everyday usage of media, but when we stay aware of NSA data surveillance tools, we certainly still have to critically investigate the algorithmic digitality and tempor(e)ality.

On the phenomenological side, it is true that communication culture has become "post-digital" insofar as computational algorithms embedded in mighty processors have become so efficient that most humans are not even aware of the discreteness of digital events (be it sound, be it vision, be it communicative interaction) unless a momentary breakdown of real-time processing happens - which leads to a common confusion between "live" (as affective experience) and "real-time" (as its technological condition). On the level of physiological perception the "analog days" return - but just as a time-continuous simulacrum, dissimulating its time-discrete and micro-archival nature of intermediary storage. In that sense, the storage-programmable computer (the "von Neumann architecture"),

coupled with predictive algorithms (the "future in the past" mode of temporalizing presence), is the technology to be focused.

Micro-archiving presence from analog to digital

The media-archaeological spelling of (micro-)tempor(e)alities on the one hand reminds of the Latin notion for *realitas* from *res*, the material artifact. Media time is embodied temporalities. The spelling of tempor(e)ality is further influenced by philosophical thoughts which relate being to time (Martin Heidegger) and proclaim a process-oriented ontology (Alfred North Whitehead). But at the same time, media archaeology is more strictly *grounded* in the technical sense. German "geerdet" (grounded) is an expression from electro-technical engineering, indicating that circuits in hardware have to be connected with the physical "mass". Media phenomenology is not necessarily restricted to human sensation, perception and mind, but extends to a kind of phenomenology *of* and *by* the machine as made possible by signal sensors. It is the "sample&hold" mechanism which not simply translates but even transsubstantiates (to borrow a term from Catholic religious liturgy) the analog physical world into digital computability.

In reading concrete techno-logical scenarios such as circuit diagrams, media archaeology identifies new "shapes of time" (George Kubler). The sample-and-hold mechanism (before the signal actually gets digitally quantised) performs the *the ephemeral archive* - with its records being "stored" only for a fraction of a millisecond. Condensers figure among the smallest electro-physical storage elements, and combined with transistors they function as micro-memories here. The electronic sound slice is a temporal being in such electronic circuits, not punctual, but a suspended instant of time as voltage.

The observational separation between past and the present has shrunk technologically into the most minute micro-temporal *différance* in digital computing. The fundamental unit of memory, the electro-magnetic relay, for electronic engineers seemed "naturally adapted to the binary system" since they did not attempt to measure gradations of charge at a particular point but were "content to distinguish two states"¹³⁵ - which makes all the difference to the time-functional classical black & white television scan line, and to analog computing. The flip-flop as truly binary device provides for the rhythm. Magnetic wires or tapes or acoustic delay line memories recognised the presence or absence of a pulse or (if a

135 Section 5.2., in: Arthur W. Burks / Herman H. Goldstine / John von Neumann, Preliminary Discussion of the Logical Design of an Electronic Computing Instrument, in: John von Neumann, Collected Works, vol. 5, ed. by A. H. Taub, Oxford (Pergamon Press) 1961, 34-79; reprint in: Swartzlander (Hg.) 1976, 221-xxx (227)

carrier frequency was used) of a pulse train.¹³⁶ All of the sudden, beyond the phenomenological notion of the continuum of time (Bergson), computer time sounds different.

A core of the operation: The sample-and-hold mechanism

The canonical sampling-theoreme describes the digital ratio of the "slicing" of a continuous signal flow in order to preserve the signal fidelity intact. The current notion of "streaming" media in online access to audiovisual content metaphorically disguises the discrete nature of signal processing and linear buffering.

In Jim Campbell's media art installation *Church on Fifth Ave* (2001), a matrix of 32 x 24 (768) pixels made out of red LEDs displays a pedestrian and auto traffic scene in New York from an off street perspective. A sheet of diffusing plexiglass is angled in front of the grid. As the pedestrians move from left to right the figures gradually go from a discrete representation to a continuous one - or metaphorically from a digital representation to an analog one.¹³⁷

The message of this installation can be understood in the media-epistemological sense. Once being subject to algorithmicized signal processing, any "analogue", apparently continuous representation of an event is irreducibly discrete - which shows up in the very artefacts ("glitches") the "post-digital" aesthetics is so fond of. This is noticeable on the margins of the Campbell QuickTime Movie itself. The analogue here becomes a retro-nostalgic re-entry *within* the digital.

Human perception tends to smooth discrete data into coherent signals anyway, since it functions as a kind of digital-to-analog converter, when confronted with the pixelised image resolution - just like in mechanical cinema frame sequences and analog television scan images already.

Epistemologically, the digital infinitesimally approximates the physical world. But the perfidious power of "the digital" unfolds with Digital Signal Processing, since this allows to simulate the "worldly" analog signal in high *temporal* fidelity - like physical modelling does with instruments in electronic music.

Between the analog and the (post-)digital a techno-mathematical operation reigns. Any periodic wave signal - be it auditory in the time domain or a visual pattern in space - can in reverse, by means of the

¹³⁶ Burks et al. 1961 / 1976: 227

¹³⁷

http://www.jimcampbell.tv/portfolio/low_resolution_works/fifth_avenue/church_on_fifth_avenue

Fourier Transform, be numerically addressed in the frequency domain and thereby becomes accessible to computing intelligence.

In times of communication technologies which are based on the Sampling Theorem, the human sense for the difference a natural and an artificial sound or movement fails. Digital computers have become capable to successfully re-voice the analogue world.

Media archaeology locates the scene of the "digital" where it precisely happens. Every digital device, in its physical media-archaeological essence, remains ultimately analogue in the temporal sense. Any switching between two binary states from low voltage "zero" to a higher level "one", however abrupt, is (electro-)physically time-consuming but literally *does not count*; Spencer-Brown's term "drawing a distinction" is a time-critical act itself. According to Adrian Mackenzie, such "dead-time refers to a spacing or non-identity 'within the presence of the living-present [...]"¹³⁸. Norbert Wiener once coined this by the enigmatic expression "time of non-reality".¹³⁹ This *inbetween* is the temporal equivalent the Aristotelean notion of *to metaxy* which became, in Latin scholastic translation, the *medium* of signal transmission.

Luciano Floridi, describing the phenomena of ubiquitous computing and the "Internet of things", sees "[t]he threshold between *here (analogue, carbon-based, off-line)* and *there (digital, silicon-based, online)* [...] fast becoming blurred [...]. The digital is spilling over into the analogue and merging with it."¹⁴⁰ This actually extends to the temporal dimension: "[T]he very distinction between online and offline will disappear."¹⁴¹ Indeed, Global Positioning Systems calculate a position in space as a triangulation of signal runtime differences - space becomes a function of time-critical communication. "Radio Frequency Identification (RFID) tags store and remotely retrieve data from an object and give it a unique identity, "like a barcode" (ibid.). Thereby the material present is coupled to the archive already.

ALIEN TEMPOR(E)ALITY. The Clash between Symbolical Time and the *Temporeal* in the Technosphere

The *technochrónos* hypothesis

138 Adrian Mackenzie, *The Mortality of the Virtual. Real-time, Archive and Dead-time in Information Network*, in: *Convergence* Bd. 3, Heft 2 (1997), 59-71 (67)

139 See Claus Pias, *Time of Non-Reality. Miszellen zum Thema Zeit und Auflösung*, in: Axel Volmar (ed.), *Zeitkritische Medien*, Berlin (Kulturverlag Kadmos) 2009, 267-279

140 Luciano Floridi, *Information. A very short introduction*, Oxford / New York (Oxford UP) 2010, 16

141 Floridi 2010: 16

Maybe what drives humans to extended walks in the forest nearby their city is the sense of its other temporality, with the trees reminding of a slowed down pace. But instead of a cultural, aesthetic, or media-phenomenological analysis of the theme "From heterotopias to heterochronias"¹⁴², a more "radical" media archaeology, with regards to the episteme of *technológos*, rather approaches "heterochronia" *from within* the technological perspective.

The discussion of "heterochronia", which has been inspired by Michail Bakhtin's concept of the "chronotope" and Michel Foucault's analysis of "other places"¹⁴³, is mainly related to the literary, and cultural, discourse. Bakhtin already admitted that he has been "borrowing" the concept of "time space" from Einstein's *Theory of Relativity* "for literary criticism almost as a metaphor (almost, but not entirely)"¹⁴⁴. In its epistemic resistance to culturocentric metaphorization, radical media archaeology is a way to detect the "other times" rather *within* the machines, and to describe them in their own technical terms. A "chronotopic" place like the door, which aesthetically might be charged with the imaginary of meeting or farewell, might first of all be reduced to its function as cultural technique of inclusion or exclusion (Foucault), or opening and closing¹⁴⁵, and in a more media-analytic sense be "grounded" in the circuitry of logical gates, like the flipflop. While Foucault's variation of the "heterochrony", which culminates at the moment when humans break with their customary time (be it endless accumulation like in libraries, or short-term temporal ekstasy like carnaval¹⁴⁶, is still anthropocentric, the media-archaeological focus on concrete techno-chronical scenarios prevents such an analysis from the allure of an all to speculative (tempo-)realism.

Technological devices - different from previous cultural techniques and

142 This has been the topic of a PhD-training seminar at the Norwegian Institute in Paris, April 28 to 30, 2020

143 Michel Foucault, *Of Other Spaces: Utopias and Heterotopias*, translated by Jay Miskowiec from the French version ("Des Espace Autres", published in: *Architecture / Mouvement / Continuité*, October 1984), in: *Diacritics*, Spring 1986, 22-26; quoted here from the online version

<http://web.mit.edu/allanmc/www/foucault1.pdf>, accessed 12 February, 2019

144 Michail Bakhtin, *Forms of time and of the chronotope in the novel* [Russian original Moskov 1975], in: idem, *The Dialogic Imagination*. Austin (Univ. Texas Press) 1981, 84-258 (84 seq.)

145 See Bernhard Siegert, *Cultural Techniques: Grids, Filters, Doors, and Other Articulations of the Real*, transl. Geoffrey Winthrop-Young, New York (Fordham University Press) 2014

146 "Die Heterotopie erreicht ihr volles Funktionieren, wenn die Menschen mit ihrer herkömmlichen Zeit brechen": Michel Foucault, *Andere Räume* [FO 1967], in: Karlheinz Barck et al. (ed.), *Aisthesis. Wahrnehmung heute oder Perspektiven einer anderen Ästhetik*, 5th ed. Leipzig (Reclam) 1993, 43

trivial machines - embody a tempor(e)ality of its own. Since technologies come into their media-being only when being operative and signal processing, as chrono-techniques, their *technológos* is essentially intertwined with the question of time.

The *technológos* hypothesis does not claim any metaphysical reality, though. Technological devices have been functionally engineered, and programmed, with a rational design. But such a design, once it is implemented into real matter, knows more than its inventors. Different from Harman's and others' object-oriented ontology, media archaeology is the method to investigate this hypothesis radically, that is: grounding it in actual material reality (hardware, electronics), and the symbolic order (software, code), as precise as possible. Like hermeneutics is applied to reading texts to unfold their implicit meaning, radical media archaeology investigates the techno-logical diagram (such as circuit design and algorithmic flow charts), and its material implementation (its actual circuitry) to reveal its *technológos*.

Most radically, *within* technologies, an *alienation* from the human, or cultural, sense of time takes place. In regard to this heterochronia of technologies as such, the expression "alien temporality" alludes to Ian Bogost's *Alien Phenomenology* (2012). It replaces the anthropocentric analysis of human "inner sense of time" (in terms of Edmund Husserl¹⁴⁷) by a second-order observation, which is the question how "time" is presented to *another entity*¹⁴⁸, the measuring "sensors" from the point of view of the machine. This leads to a techno-logical, rather machine-oriented phenomenology. Rejecting the notion that there is one homogeneous time "containing" (or rather, in Heidegger's techno-logical sense "enframing") all entities, machine-oriented ontology (MOO)¹⁴⁹ rather insists that "times arise from machines as well"¹⁵⁰. In allusion to Immanuel Kant's definition of the cognitive temporal *a priori*, machine time is nothing other than a form of its inner-technological sense. This sense becomes concrete in sensors like the A/D converter that transduces "analog" time-continuous signals into "digital", that is: computable frequencies. Looked at in this perspective, "[e]very machine has its internal form of temporality and these temporal rhythms differ among themselves" (Bryant *ibid.*).

Techno-Logically Induced "Time" Figures

147 Edmund Husserl, *On the phenomenology of the consciousness of internal time* (1893-1917), transl. John Barnett Brough, Dordrecht (Kluwer Academic Publishers) 1991

148 Levi R. Bryant, *Onto-Catography. An Ontology of Machines and Media*, Edinburgh (Edinburgh University Press) 2014, 62

149 Bryant 2014: 15

150 Bryant 2014: 157

In vernacular discourse, the notion of "time" is rather diffuse, and can actually be grounded and precized by counter-checking the *termini technici* for timing in engineering. As it has been remarked in the introduction by Lionel Pearson to Aristoxenus' *Elementa Rhythmica*: "One of the difficulties in reading Aristoxenus is to distinguish the special or technical use of a word from its general meaning. Greeks of his time were devising their own technical and scientific terminology."¹⁵¹

In the Aristotelean definition, time comes into existence only by counting intervals; his disciple Aristoxenus, in his fragment on Rhythm, coined the term *chronoi* ("times") in the plural, for rhythmic prosodic, or musical articulations in micro-time. All kinds of rhythms and tempor(e)alities chronopoietically unfold from within the machine, even when they are not noticed by humans at all. Chronotechnical analysis is required to reveal the implicit temporalities of technical beings, and to identify their *chronoi*. Aristoxenus' term for the smallest rhythmical units of long and short intervals can be extended, or re-actualized, to the data cycling units in digital computation.

Radically new, techno-mathematic forms of trans-temporality result in an epistemological turn of "time"; e. g. the notion of "recursion", as time-figure, has been triggered by algorithmic thinking.

Technologies turn "time" into an epistemic toy. For example, the so-called Harmonizer allows for pitching voices from male to female bandwidths in real-time, avoiding the magnetophonic Mickey Mouse effect which arises from a speeding up of the tape. This requires real-time calculation from within a microchip, and has been the reasons for younger Friedrich Kittler to learn to program in Assembly code, which is necessary for carrying out such time-critical tasks. And the Ableton Live sound editing software allows for rhythm manipulation. Dynamic time warping is based on an algorithm that measures similarities between two temporal sequences and equalizes them. When a rhythm is played by a real drummer, this beat feels human exactly by not being always just in time; Warp Markers allow bringing various loops into sync with one another. In reverse, other software allows for a rehumanizing of electronic drum machines, remediating algorithmic reasoning with the music rhythm.¹⁵²

The challenge which arises from technological media to the cultural notion of "time" does not simply lead to further variations of the individual or collective sense of time, but essentially transforms the ontology and the functionality of time itself. As its *other* ("alien" heterochronia), the tempor(e)alities of technical media pose a challenge

151 Aristoxenus, *Elementa Rhythmica*. The Fragment of Book II and the Additional Evidence for Aristoxenian Rhythmic Theory, Oxford (Clarendon Press) 1990, xxxiv, note 20

152 See Shintaro Miyazaki, *Algorhythms*. Understanding Micro-Temporality in Computational Cultures, *Computational Culture* 2 (2012), online

to symbolical (cultural and historiographical) "time". The semantics of so-called "time" as a transcendent signifier in cultural discourse, already lags behind against the techno-logical description of escalated media *timings*. Terms for such *timing* in communication engineering like "delay", "loop" or "realtime", turn out more precise than the inherited phenomenological semantics of "historical" time, or the "inner sense of time" (Husserl). When the medical "slowing down" of the Cobid-19 virus pandemic clashes with the just-in-time mode of industrial production, the analysis of such a condition gets more precise once it has been trained in such techno-logical terms.

The mathematical theory of information has transformed both the scientific understanding, and engineering of communication. This media-epistemic shift has already created new cognitive territories - in theory. In practice, cultural discourse semantically lags behind the state in which digital technologies already are and act. Digital information has not yet changed cultural conventions of how humans conceive and inhabit space and time, nor the predominant discourse of history itself, while practically resulting in new, multiple kinds of tempor(e)alities already. Technological chronopoietics involves alternative modes of dealing with what occidental discourse used to call "history" - if not denying "time" as such. Time itself is a transcendent signifier no more: "Time probably appears to us only as one of the various distributive operations that are possible for the elements that are spread out in space."¹⁵³

From "Time" to Frequency Domain

"Radical" media archaeological analysis identifies the concrete scenarios (media theatre) where the symbolical, cultural time regime confronts the entropic temporality of real matter, its thermodynamics. From that derives the typographical play of characters in "tempor(e)alities". On that stage, a cognitive chrono-logical concept confronts the techno-logical real.

[By time-critical analysis, tempor(e)alities turn out, which operate below and beyond human sense of time. "Non-human time is the order of the day, be it the fatal geological time of the Anthropocene or the nanoseconds of the algorithms informing our mediated realities" (Call for papers Paris PhD training seminar). On a macro-time scale, a multiplicity of temporal layers occurs with the Anthropocene discourse indeed. Since human-centered culture has begun to leave an everlasting footprint of the earth's crust, the complex, layered interrelation between "social time, technological time, and human time in relation to deep time, archaeological time, planetary time"¹⁵⁴ is reconsidered. But the climate change debate is still anthropocentric. It is negligent of another drama

153 Foucault 1986

that concerns the *cognitive* environment. In parallel to human-induced climate change, a "noosphere" (Teilhard de Chardin) has arisen, a new kind of environment (McLuhan) which arises from *within* technology and its logi(sti)cs.]

To *unthink* time is impossible for human intuition, according to Immanuel Kant's concept of the tempo-spatial *a priori*. But this can be achieved by switching temporal observation to the technomathematical machine. Does it really make sense for the nonhuman observer - and the "radical" media-archaeological point of view - to suppose a dimension called "time" at all? Process-oriented ontology¹⁵⁵ asks to think technologies from *within*, to consider the time of the machine as opposed to the human time of experience. "[W]hat makes questions of temporality and experiences of media aesthetically interesting are situations in which multiple temporalities are present and rub against each other"¹⁵⁶, such as the cinematic gap which opens between the nonhuman, time-critical projection mechanism, and the human experience of continuous movement. A media dispositif, such as cinema, is a system consisting of human and non-human agencies (in terms of ANT). Media phenomenologically, what counts in a cinema screening is its usually ninety minutes symbolic time frame to actually tell a narrative that may, in the imaginary time, last two months. But cinematography's own temporality, which is the condition for that phenomenological time experience, is only subliminally accessible to humans: It is the machinic event unit of twenty-four frames per second, which in combination with the discrete clock-like intermittent machinery, and the turning shutter, betrays the human sense of continuous movement. This inner machine time is linked to other realities than the human film experience - it is actually closer to the step-wise algorithm (Miyazaki) of the Turing machine. "There is therefore a time in or of the medium, but is that really the only thing that matters when I go to the movies? No." says Koepnick (ibid.). In his media anthropocentrism, "[w]hat really matters is the relations and tensions between the mechanical time of the film, the plot time of the film the story time of the film, the time it takes to watch the film, and the kind of time that we bring as viewers to the auditorium, our memories and anticipations, our patience and durational commitments, our expectations and curiosity - and it is the meshing and interactions of all these different times that makes the experience of watching a film aesthetically interesting." (Koepnick ibid.)]

154 Katja Kwastek, in: *The Aesthetics and Politics of Slowness: A Conversation*, in: *ASAP/Journal* 4.3 (September 2019), 467-483 (479)

155 See Bryant's insistence on the "operative" qualities of the machine: 2014: 38

156 Lutz Koepnick (author of *On Slowness: Towards an Aesthetics of the Contemporary*, New York: Columbia University Press, 2014) in: *The Aesthetics and Politics of Slowness: A Conversation*, in: *ASAP/Journal* 4.3 (September 2019), 467-483 (479)

But this anthropocentric time experience is not the only interesting aspect for media-epistemological investigation. Machine-Oriented Ontology has a different kind of perception. What literally *matters* here is the machine *aisthesis* as well, which is a function of its technical materiality, and logical coding. In order to call this nonhuman sense of time to attention, the cultural semantics and vocabulary "time" is displaced (if not even replaced) by technical terms for a multitude non-discursive temporal operations. Subjective, collective, or aesthetic temporal experience such as "slowness" is rather addressed, and technologically modelled, in terms of signal processing, the "delta- t " for intervals, and its concrete materializations: the "reverb", or the magnetic tape loop, in electroacoustics to achieve an echo effect, or the "delay line" for regenerative data memory in fast computing (RAM). Electronic media operate on the basis of a technical rather than affective sense of timescales.

What radical media archaeology is aiming for is - at least momentarily - a suspense of analysis from the human time experience, which is aesthetic, and phenomenological time, in favour of looking specifically at what the technical medium does. For example, in computing there is "the idea of command and execution in algorithmic code and specifically the moment of it not working - that is, that a command doesn't necessarily mean that there is an execution, which brings to the fore a thinking in a completely different kind of time that is not human but machinic."¹⁵⁷

There is no "digital time" in its proper sense. In computing, the frequency domain turns out as the reversal of the familiar time domain. What appears as "time signals" to humans, after Joseph Fourier's mathematical analysis of vibrational events in his 1822 *Théorie analytique de la chaleur* (The Analytical Theory of Heat), can be decomposed into its single sinusoid partials which can be addressed in terms of their amplitude and frequency. In computing, this becomes the discrete operation of numbers.

Technomathematical discrete time sampling is most discrete microtemporal segmentation. Once signals from the time domain (such as wave forms) have been computationally sampled in A/D conversion, they do not exist in time at all any more, but rather in its mathematical reversal, this is, in the frequency domain which can be numerically addressed and thereby communicated to the digital computer. This makes it accessible to numerical algorithms, that is: chronopoietic tools instead of an a priori called "time"; Fast Fourier Transform an algorithm that computes how temporal sequences can change from the time domain into the frequency domain.

¹⁵⁷Erin La Cour, in: *The Aesthetics and Politics of Slowness: A Conversation*, in: *ASAP/Journal* 4.3 (September 2019), 467-483 (479)

The elementary unit of technological being-in-time is the time-varying signal for analog media; for the digital, it is discrete pulses. Fourier analysis transforms the temporality of the physical signal into a mathematical pattern, which is the frequency domain of its single components.

What if there is, in information theory, not even multilayered temporalities, but no more "time" at all, when thermodynamic entropy is replaced by Shannon entropy? Binary computation is generating new epistemic time-objects instead, like ergodic time, Markov chains, and Wiener's notion of a "time of non-reality" which occurs between binary switching states. In principle (*en arché*), at "bit" is timeless in its lossless reproducibility and calculability.

"Real-time", "live", storage

In contrast to media phenomenology, which relates to the human experience of technically induced realities, radical media-archaeological analysis reveals figures of timing, which occur within technologies. These are *alien* to the human "inner" sense of time in terms of its different chrono-logics, and *alienated* from the human since in high-frequency electronics, and computing, the temporal event surpasses, or recedes behind, human awareness.

Norbert Wiener's notion of a "time of non-reality" names the switching interval between two alternating voltage states in a flipflop circuit.¹⁵⁸ This *tempoReal* literally *counts*. The very same Norbert Wiener has been involved in war time research on anti-aircraft prediction for artillery. In the German case, such calculation of the *futurum exactum* as deadly time figure has been operated by the Kommandogerät 40, which has been the analog computer to predict the enemy aircraft movements and the time-critical release of the projectile.¹⁵⁹ The term "real-time" is, in similar, less military contexts as well, a betrayal of the present moment. For just-in-time processing, real-time rather refers to a temporal interval, which is defined, and relativized, by a task to be performed. In human-computer interaction (like video gaming), computational "real-time" is relative to the human phenomenology of a temporal time-window called "the present".

Real-time computing hardware and software systems (*aka* reactive

158 See Claus Pias, *Elektronenhirn und verbotene Zone. Zur kybernetischen Ökonomie des Digitalen*, in: Jens Schröter / Alexander Böhnke (eds.), *Analog/Digital – Opposition oder Kontinuum? Zur Theorie und Geschichte einer Unterscheidung*, Bielefeld (Transcript) 2004, 295-309

159 See Werner Müller, *Die Geschütze, Ortungs- und Feuerleitgeräte der schweren Flak, Friedberg* (Podzun - Pallas) 1988, chap. "Kommandogerät 40 (Kdo.Ger. 40)", 170-181

computing) are subject to constraints in bitstream transfer, such as the operational deadlines from an event to its system response. By contrast, a *non-real-time system* is one for which there is no deadline, even if fast response or high performance is desired or preferred. "A real time system may be one where its application can be considered (within context) to be mission critical."¹⁶⁰

The term *real-time* derives from its use in early simulation. While its current usage implies that a computation is "real-time" when it is "fast enough", originally it referred to a simulation that proceeded at a rate that matched that of the real process it was simulating. Analog computers have been capable of simulating an event much *faster* than in real-time.

Already the concept of "live" transmission of radio, and television content, only makes sense in terms of human *aisthesis*, but has been a betrayal of the physical temporal gap. Even in ultra-speedy electromagnetic waves a minimum delay occurs, which finds its limits by the speed of light. When it comes to sound propagation, this delay is more critical, since human ears soon sense a temporal delay in acoustic waves that travel with comparatively slow speed of 330 m / sec. That is why, in time-critical analysis, the umbrella term "audio-visual" media breaks apart with the asymmetry, for human senses, between the transmission of electromagnetic and of mechanical waves.

Already the technical effect of electronic tele-presence has transformed the contemporary into rigid signal synchronization. In terms of engineering, the electric *resonant circuit* enables radio communication, and only the time-critical, exact synchronization of "live" television signal transmission and reception creates the impression of a steady image for the human eye. Only in the cosmic dimension, electro-magnetic signal delay becomes visible in the distortion of *moving* targets like astronauts in Slow Scan Television transmission to the observer on earth.

In reverse, storage media constitute a kind of suspended time channel of signal transmission.

Thermodynamic Versus Logical Time: Reversible Computing

With any machine implementation of logical reasoning and algorithmic computation, between the input signal and its output, bits get lost in the course of their calculation by logical gates. For an AND operation, e. g., from two input signals, only one output signal results. This informational loss can be measured in terms of entropy, and its physical loss is the emittance of heat. Here, the symbolic order confront the material:

160 http://en.wikipedia.org/wiki/Real-time_computing

logical states are treated like physical states, they are subject to the laws of thermodynamics¹⁶¹, which induces its irreversibility. But logical operations, as it has been demonstrated by Landauer, can be formulated in a reversible way, so the initial state can be inferred from the final state. This includes the necessity for increased storage of bits, though, which otherwise get lost in calculation. For experimental, media-epistemic investigation, such computers have actually been constructed.

Sublime Temporalities: Nuclear, and Aesthetics Time-Criticality

A case where both heterotopia (in Foucault's sense of "Other Spaces"), and heterochronia, intertwine, is the challenge of how to communicate the danger of nuclear waste deposits to the far future, and possible "aliens".

High-speed photography has played a decisive role in analysing, and documenting, the first nuclear tests, which goes along with the development of the effective von Neumann architecture of computing to pre-calculate such nuclear fissions. Such time-critical series of micro-events are neither perceivable, nor calculable, for humans any more. From that derives the aesthetics of a "sublime" media temporality - both as speed, or as slowness. John Cage composition *As SLOW as POSSIBLE* for piano first, then for organ, makes the listener "think about durations that may exceed human existence" (Kwastek: 481) - which, in the Halberstadt organ installation, will actually last for 600 years to play.

In his thoughts on so-called Harmonic Analysis, Norbert Wiener refers to the lowest organ tone, which results in pulses rather than tones for human perception. But even for seemingly continuous tonal events, the machine knows its different, discrete time. But when slowing down acoustic vibrations as such, an alienation takes place. "What if you could slow down the playback of sound to an almost standstill?" [...] in looking at the tides I was faced with an oscillation that moves in a wavelike manner at a decelerated speed that, for humans, might resemble just that: an almost standstill."¹⁶²

Tide prediction machines have been devised by Lord Kelvin in 1872, which is an analog computer for real-time simulation. The "acoustic episteme" of vibrational force (Goodman) and oscillations (Oersted) has

161 "Behandelt man logische Zustände wie physikalische, so gelten für sie die Regeln der Thermodynamik";

https://de.wikipedia.org/wiki/Reversibles_Computing, accessed 13 February, 2020

162 David Gauthier, Phase to Phase: On Oceanic Oscillations, Measurements, Predictions, and Chronographs, in: *The Aesthetics and Politics of Slowness: A Conversation*, in: *ASAP/Journal* 4.3 (September 2019), 487-495 (488)

been triggering computational reasoning indeed.¹⁶³

The focus on the complexities of experienced time, and the media-induced irritations of the human sense of the present, is still an anthropocentric perspective, against which object-oriented ontology, media-archaeological materialism, and the *technológos* hypothesis, set an autonomous thing-processuality.

With(in) technology, "time" is turned from an *a priori*, or transcendent signified, into an operational signifier. The clock generator in computer CPUs is timing in the sense of symbolical time-giving, while at the same time being a subject to entropic temporality at the same time. The "clock rate" in computers is derived from the frequency of an oscillator crystal which is, first of all, is producing a "sonic" time signal: a fairly precise sine wave. It is then the temporal "drama" on the stage of the media "theatre" of electronic circuitry, which transforms the analogue into a digital square wave to make it accessible for, and adjust it to, computing applications in its discrete sense of time. "Treat time as discrete", Turing advised.¹⁶⁴ A clock distribution network *inside* the CPU is responsible for the time slots which characterize time-discrete computing, as a micro-infrastructure of literally "hard-wired temporality"¹⁶⁵.

The focus on time-critical technologies allows to locate the precise techno-epistemic momentum of "digitization" in the translation of the physical world into the regime of computation. An A/D converter is provided with a "clock" pin to set the sampling rate. Under- and overclocking, as temporal information, arrives at the border of entropy - the intentional reduction, or increase of waste heat produced by the CPU (as adversarial acceleration of microchip ageing). In graphene-based transistors, electrons are capable of tunnelling at low voltages and therefore leads to ultra(s)low power consumption, enabling increased processor clock speeds.¹⁶⁶

Radical media archaeology looks as precise as possible at such time-criticality: "After each clock pulse, the signal lines inside the CPU need time to settle to their new state. That is, every signal line must finish transitioning from 0 to 1, from 1 to 0. If the next clock pulse comes

163 See Charles Babbage, *On the Permanent Impression of Our Words and Actions on the Globe We Inhabit*, in: *The Works of Charles Babbage*, edited by Martin Campbell-Kelly, vol. 9: *The Ninth Bridgewater Treatise. A Fragment*, 2nd edition [1838], London (Pickering) 1989, chap. IX, 35-39

164 Turing, *State of the Art*, xxx

165 See the forthcoming *Hardwired Temporalities* book project by Kyle Stine / Axel Volmar (eds.), Amsterdam UP (Recursions series)

166 <https://phys.org/news/2016-05-graphene-based-...>, accessed February 26, 2020

before that, the results will be incorrect"¹⁶⁷. This "time of non-reality" (as it has been coined by Norbert Wiener) reminds of neuron relaxation time in the human brain, which triggered cybernetic system thinking.

"[T]he polytemporality of the present, the increasing heterogeneity of the timescapes we inhabit"¹⁶⁸, are pluralizing "time" into *chronoi* (Aristoxenus). But "rhythmanalysis"¹⁶⁹ does not only refer to the cultural, but to the nonhuman chronosphere as well. The "cycles" in computer data processing rather correspond to the musical rhythm than to the simple meter that is the "clock time" of music.¹⁷⁰

The Clock as Time-Keeper, and the "Y2K Bug"

Cultural analysis pays attention to the historical complexities of temporal concepts and spatial forms, but the "historical" is itself, already, a function of a symbolical temporal (in-)formation.

Technological media are not just an escalation in the long genealogy of cultural techniques, but they develop self-referential, auto-poetic tempor(e)alities which alter or irritate the established phenomenological categories of "inner" time perception and cultural memory. For this *other time* to happen, in the cybernetic sense, "[i]l faut que cela fonctionne dans le réel et indépendamment de toute subjectivité"¹⁷¹. The sun-dial itself serves as a circular argument of how time comes into being only by symbolic discretization, that is: the symbolical machine: "Depuis toujours, l'homme à cherché à conjoindre le réel et le jeu de symboles. [...] il a mis des chiffres à l'endroit où s'arrêtait, à chaque heure du jour, l'ombre du soleil" (ibid.). Such new chrono-poetic figures require a close reading of actual technical operations within time-critical and time-based media (their tempo-realities), while challenging the notion of traditional philosophy of time in favour of genuine media-temporality

Lacan emphasizes "to what extent it is essential to our being-there, as they say, to know the time"¹⁷², which is the *chronológos*. He reminds of

167 Entry "Clock rate", https://en.wikipedia.org/wiki/Clock_rate; accessed February 26, 2020

168 From "the call for paper" (May 2020) to an edited collection by Natasha Lushetich / Iain Campbell, *RESONANCE: Axiologies of Distributed Perception*

169 Henri Lefebvre, *Rhythmanalysis [1992]: Space, Time and Everyday Life*, transl. Stuart Elden and Gerald Moore, London: Continuum 2004

170 See Koepnik 2019: 480

171 Jacques Lacan, *Le séminaire. Livre II: Le moi dans la théorie de Freud et dans la technique de la psychanalyse*, Paris (Éditions du Seuil) 1978, 346

172 Jacques Lacan, *Freud, Hegel and the machine*, in: *The Seminar of Jacques Lacan*, edited by Jacques-Alain Miller, Book II: *The Ego in Freud's Theory and in the Technique of Psychoanalysis 1954-1955*, transl. Sylvana Tomaselli, New York / London (W. W. Norton & Company) 1991, 64-76 (74)

the role of clocks in the early modern episteme, which is exactly the Cartesean epoch Heidegger refers to, in his lecture "Time of World-Image". Such clocks worked by weights (energetic entropy), but they "embodied the measure of time" by quantizing (negentropically) the apparent, phenomenal "flux" of time with their escapement mechanism. The core chronological drama is how the tempoReal of entropic time is adjusted to the symbolic order of "vulgar" clock time - and how ergodic (computer games) time, in reverse, is implemented in entropic materiality.¹⁷³

"A lot can be said about this time not being the real one, it still passes there, in the clock, all alone [...]" (74). For his interpretation of the clock as time *machine*, Lacan then strongly recommends the reading of Descartes' posthumously published book called *Of Man*, which gives a machine description of the human body. "Flip through it, and confirm that what Descartes is looking for in man is the clock. [...] It isn't purely and simply the opposite of the living, the simulacrum of the living. That it was constructed so as to embody something which is called time and is the mystery of mysteries, should put us on the right track. What is in play in the machine? That at the same time someone called Pascal busied himself constructing a machine, still very modest, making additions, shows us that the machine is tied to radically human functions. It isn't a simple artifact, as could be said of chairs, tables, and of other more or less symbolic objects, among which we live [...]. Machines are something else. They go much further in the direction of what we are in reality, further even than the people who build them suspect" (74). Philosopher Hegel, though, with his focus on the embodiment of the Spirit of his time, and his dream "that Napoleon was the Weltseele [...] completely failed to apprehend [meconnu] the importance of this phenomenon which was beginning to come into view in their time - the steam engine" (74). The steam engine stands for another, thermodynamic, entropic "time" than the symbolical clock time, which is, nevertheless, subject to entropy, in its mechanic frictions.¹⁷⁴

The inner-machinic temporal physics, and logics, are human to the degree that all such devices are direct artefactual functions, that is, they have been created from within techno-cultural knowledge. Technology, in its *lógos* aspect, is a physically reified mind, resulting in a second nature, Hegel's and Gotthard Günther's notion of "objectiver *Geist*" and the "second machine" *alias* computing. But on the other hand, technically

173 On John Cayley's poetry generator *The Speaking Clock* as example of "ergodic art" see Espen Aarseth, Aporia and Epiphany in Doom and The Speaking Clock. The Temporality of Ergodic Art, in: Cyberspace Textuality. Computer Technology and Literary Theory. Edited by Mary-Laure Ryan. Bloomington and Indianapolis: Indiana University Press 1999, 31-41

174 See Isabelle Stengers (with Didier Gille), Time and Representation, in: idem, Power and Invention. Situating Science, Minneapolis / London (University of Minnesota Press) 1997, 177-212

in/formed "[m]atter, far from being a passive stuff awaiting our formation or instructions instead modifies our designs on all sorts of unexpected ways. [...] The inventor of the clock did not intend for it to striate every aspect of life"¹⁷⁵, when its content had been the "clocking" of prayers in the Monastic medieval context, but its techno-chrono-logics developed in terms of McLuhan's definition of the medium as its technical *message* and temporal *massage*.

Time protocols, like the Medieval chronicles, still belong to the symbolic order, as cultural techniques, or actual technologies for imposing a temporal order upon manifold world processualities. But a different temporeality emerges when the symbolic is embodied in the real, as material instantiations like mechanical clocks. Here, the symbolic order becomes machine. The mechanism of timekeeping is slowed down by "frictions" (Clausewitz¹⁷⁶) which occur at the moment of contact between the suspended pendulum and the actual clockwork. A damping of the clockwork signals occurs unless they are negentropically kept constant by negative feedback circuitry. There is always a loss of energy in oscillations. This *momentum* asks for description "in strictly thermodynamic terms, as a dissipative system"¹⁷⁷.

While in symbolic narrative time, any event temporally unfolds between a beginning and an end, a "timeless" oscillation in *sounding* media (by feedback-coupled electron tube, or transistor circuitry) is achieved by the ideal, undamped sine tone. Only when conceptual computation becomes electronic computing, in the actually implemented encounter between symbolical chrono-*lógos* and the mateReal, temporality is re-introduced by matter and energy.

Only since Christiaan Huygens, with its isochronic oscillation, the pendulum can meet the scientific (Newtonian) requirements of an autonomous exact time.¹⁷⁸ A clock, even with astronomical revolutions as its reference time, is no embodiment of a transcendent natural time, but itself a time-generator. Essentially the clock is an analog-to-digital converter, transducing the regime of matter of energy into the symbolic time order. The motions of the pendulum and the moments of its contact with the escapement are coupled to convert potential to kinetic energy, and energy to information (Mackenzie *ibid.*). In information theory, the thermodynamic, physical, one-directional time arrow (Boltzmann entropy) is matched by entropy as mathematical measure of information value (Shannon entropy¹⁷⁹).

175 Bryant 2014: 22

176 Clausewitz, *Vom Kriege* [1832], Munich 2003: 36

177 Adrian Mackenzie, *The Technicity of Time*. From 1.00 oscillations/sec. to 9,192,631,770 Hz, in: *Time & Society* 10, nos. 2-3 (2001), 255, referring to Stengers and Gil 1997

178 Mackenzie 2001: 244

179 See Horst Völz, *Grundlagen und Inhalte der vier Varianten von Information*,

For digital machines, there is no sense of "time" at all.¹⁸⁰ For digital computing, Alan Turing advised: "Treat time as discrete."¹⁸¹ The mathematical foundation of algorithmic step-by-step calculation turns mathematics into a symbolic time machine. This symbolic ordering returns within concrete machine time. "In order to automate calculation processes, a discrete clock signal is needed. This clock signal started out with a frequency of 1 hertz (Zuse's Z1) and has, with the evolution of electronics and micro-electronics, been sped up to 4 gigahertz or more in contemporary computers."¹⁸²

A computational catastrophe of the symbolic time regime has been the so-called "Y2K bug". In the first half century of electronic computing, there has been the common method of storing in only two bytes a date from the 20th century. Its alternative is the possibility of expressing a date by counting a bit for every moment since a system dependent fixed date, such as UNIX time. But "so-called 'timer-tics' are extremely difficult to decipher if the fixed date is not known. In East German data files, many different possibilities were used to express dates or numbers"¹⁸³, resulting in *alien historicity*.

The Alienation of Time to Sound: Sonification of Computing

The earliest sound, which emanated from from digital computers, has not been its sound chips, but the direct sonification of its time-discrete von Neumann architecture. "The clock signal of early digital computers could be heard by redirecting it to a speaker membrane which oscillated in synchronicity. Computers like the Zuse Z23 or the TX-0 from MIT [...] had built-in speakers that were connected to the data bus of their processors. On this bus, only two different signals (for the binary values 0 and 1) were possible, so the speaker's membrane always oscillated within two amplitudes. The frequency of the signal depended on the change of

Wiesbaden (Springer Vieweg) 2014), and Braynt, *Machine Ontology*, xxx
180 See W. E., *As Slow as Possible? On the Machinic (Non-)Sense of the Sonic Present and Digital Indifference toward Time*, in: *ASAP/Journal* (Association for the Study of the Arts of the Present), vol 4, no. 3 (October 2019), "Slowness" issue, eds. Katja Kwastek / Erin la Cour, 671-688 (685 f.)

181 Turing, *State of the Art*, in: xxx

182 Stefan Höltgen, *Play that Pokey Music: Computer Archeological Gaming with Vintage Sound Chips*, in: *Computer Game Journal* vol. 7, pp. 213-230 (2018); <https://doi.org/10.1007/s40869-018-0068-5>, section 3

183 Michael Wettengel, *German Unification and Electronic Records: The Example of the „Kaderdatenspeicher“*, lecture Annual Meeting of the Society of American Archivists, Washington, D.C., 2. September 1995, session 59: *Bit by Bit: Perspectives on Managing Electronic Records* [forthcoming in: Seamus Ross / Edward Higgs, *Electronic Information Resources and Historians: European Perspectives*, Oxford UP 1996, typescript, 5 f.

those signals on the bus. Those speakers were implemented to help the programmer or the user detect if the computer program had crashed. In this case, the cacophony of the regular computer operations changed to a rhythmical noise from the speaker [...]. Back in the day, bored engineers [...] and hackers misapplied this technology to generate distinctive sounds. To do this, they had to write programs whose only purpose was changing the audio monitor bits. This was the technology that shifted computer sound into culture. Until the 1980s, beeper and piezo speakers were used in different computer systems for putting out '1-bit sounds'. Since the human ear cannot perceive frequencies as high as the base frequencies of even these 'slow' CPUs (ranging from a few hundred kilohertz up to 4 megahertz), programmers could use them to generate any acoustic frequencies using pulse frequency modulation. Even polyphony could be simulated" with pulse frequency modulation (Höltgen 2018, section 3).

The programming of early sound chips revealed the time-criticality of digital computing itself: "[T]he function of sound chips puts specific demands onto the programmer. He or she has to code 'in time' with the system to generate rhythmically correct sound outputs. Programming the TIA (and the other PSGs that followed) requires an exact calculation of the program's time requirements" (Höltgen, 2018, section 4).

"Mobility"? Between Spatial and Temporal Transfer

For an analysis of this current media situation, and tracing tempor(e)alities in the age of "mobile media", the very term "mobile media" already lags behind, which is a left-over from the discourse of modernity and its material transport vehicles. Mobility is still associated with linear ("analog") migrations and non-linear ("digital") dislocations in topological space and time; within the *temporal* and diagrammatic dimensions of mobility in media-based communication, though, the despotic signifier "time" itself implodes. From there results the necessity for alternative descriptions of the dynamics within the chrono-poietical field. The plausibility of the category "mobility" for analysing the current condition turns out as an antiquated remnant of modernism, which blinds the insight into the topologies, diagrams and graphs of networked (chrono-)spheres. In the present "digital" condition, it is rather techno-mathematical topologies ("Internet traffic") and heterochronotopies which dominate communication.

Delayed Transfer

As it has been described by system theorist Niklas Luhmann, state administration and bureaucratic governance allow for delayed transfer when actual files are recorded in alphabetic writing, and provided with a

symbolic time stamp. The textual fixation of processual decisions does not save time but dates.¹⁸⁴ On the large, "historic" time scale, similar intermediary storage institutions, like the archive (for legal bureaucratic memory), the library (open access), and the museum (material heritage), have been developed for macro-temporal cultural "tradition". Such conventional heterochronic, time-suspended institutions ("découpages singuliers du temps", in Foucault's wording¹⁸⁵) by the digitization of its cultural content, and their online alignment to the Internet chronosphere, transmute from enduring spatial storage to delayed transfer.

Recirculating Digital Memory: the Delay Line

While institutions like the archive, libraries, or museums, remain within the familiar sphere of cultural techniques, inner-technological delayed transmission is *alienating* heterochronics, such as the buffer for short-term storage in the Central Processing Unit of computing. The acoustic delay line, or the cathode ray-based Williams Tube, have been developed for high-frequency electronic computing, to enable such a dynamic Random Access Memory.

With the bi-polar oscillation between transmission and storage in cultural tradition, the conquering space or time (in terms of Harold Innis' media definition of the essence of empires by their mode of communications¹⁸⁶) is bound to cultural techniques, that is: human symbol manipulation. Within the microcosms of digital memory, records become autonomous as signals, and biased by electricity, even the symbolical code is enabled to "fly with their own wings" (Jacques Lacan¹⁸⁷). Such signals are either fixed in magnetic *latency* (like in the ferrit core memory), or circulate in electrified algorithmic motion.

In its magnetic fixation, memory is becoming a latency, while it becomes directly coupled to an extended time window of the present in feedback loops, which results in the periodic up-dating of data as signals.

Cybernetician Horst Völz has envisioned a dynamic storage medium operated by wave speed, using thermic metaphors. In a closed circuit delay line, the signal as information carrier, at any time, is at a different

184 Niklas Luhmann, die Knappheit der Zeit und die Vordringlichkeit des Befristeten, orig. in: Die Verwaltung, vol. 1 (1968), 3-30; reprint in: Ernst Lukas / Veronika Tacke (eds.), Die Wirklichkeit der Organisation, Wiesbaden (Springer Fachmedien) 2018, 355-384

185 Michel Foucault, Les utopies réelles ou lieux et autres lieux, in: idem, OEuvres, vol. 2, Paris (Gallimard) 2015, 1238-1247 (1243)

186 Harold A. Innis, Empire and Communications, Oxford (Oxford UP) 1950

187 Jacques Lacan, Psychoanalysis and cybernetics, or on the nature of language [1955], in: Miller (ed.) 1978 / 1991: 294-308 (300)

point of space. By high-frequency modulation, though, it is possible to "freeze" such dynamic memory.¹⁸⁸

Such a dynamic data manipulation has been known from the times of early dynamic computer "memories", such as the mercury-based acoustic (ultrasonic), and other delay lines. Hereby, recirculating binary pulse trains function as a variable, scalable temporal interval. In a subtle media-epistemic shift of emphasis, this mechanism displaces the cultural idealism of eternal storage in favour of a short-term, intermediary memory. But in a close reading of such technologies, a tight coupling of temperature and memory arises: Mercury delay lines are highly sensitive to temperature variation, thereby limiting or even distorting the clocked pulse trains in the intermediary memory channel. Symbolic *timing* in computing is suddenly intertwined with entropic, physical time again. "The variation in the delay through mercury depends only on temperature."¹⁸⁹ What occurs in storage technologies here, is true for the transmission of signals as well: In echo-location by the sonar (different from RADAR that is based on electro-magnetic waves), which depends on measuring the $\Delta-t$ passing between sending and receiving back the ultra-sonic (thus vibrational, mechanical) signal, time-criticality becomes temperature-critical, since the speed of an acoustic signal considerably varies with the temperature of the air as channel of transmission.

From "Live" Analog Telecommunication to Internet Synchronization

"Serial" time, which is known from television as a program format, has been part of a geometrization (mathematization, rather than spatialization) of time as opposed to the sense of "enduring" time, as it has been expressed in Henri Bergson's critique of chronophotography.

"In the space-time world of electric technology" already, "the older mechanical time" had begun "to feel unacceptable"¹⁹⁰; linear perception has thereby been replaced by synchronisation. "By electric tapes, synchronization of any number of different acts can be simultaneous. Thus the mechanical principle of analysis in series has come to an end" (ibid.).

188 "Zu einem passenden Zeitpunkt wird durch ein kurzzeitiges Hochfrequenzfeld die Welle im Kabel fixiert (gespeichert, eingefroren)." Horst Völz, Versuch einer systematischen und perspektivischen Analyse der Speicherung von Informationen, in: Die Technik 20 (1965) 10, 650-659 (659)
189 T. Kite Sharpless, Mercury delay lines as a memory unit, in: Proceedings of a Symposium on Large-Scale Calculating Machinery, Cambridge, Mass. (Harvard University Press) 1948, 103-109 (105)
190 McLuhan 1964: 152

The digitizing of signals in communication channels has transformed the *time* of transmission into counting by numbers. This becomes evident in the PING signal as a test for internet communication, with its "time-to-live" as a decreasing number count, and symbolical clocking.

The very term "synchronization" is indicative of the arbitrary symbolic regime: technically forced time.¹⁹¹ Against contemporary face-to-face dialogue in real space, there is the technical reality of asynchronous Internet communication. Part of its transport "layer", in media-archaeological terms, is the User Datagram Protocol for enabling "low latency and loss-tolerating connections on the internet, like voice over IP or video streaming"¹⁹². Different from the control regime¹⁹³ of the TCP protocol for reliable host-to-host communication, which fragments data sets into small packages that find their route over the network without loss (unless its "Time-to-live"), UDP might lose some of its datagrams during transmission "according to its best-effort approach, a circumstance that implies an entirely different understanding of what communication is" (Apprich *ibid.*) - but only when "[t]ranslated into cultural theory" (*ibid.*).

The temporality of "Social" Media is revealed to humans once they are coupled to its machine diagram. A cybernetic *chronorganism* arises once this escalates from "loose" to (almost) "tight", rigid man-machine coupling¹⁹⁴. The Global Metronome Project techno-operationally allows for absolute tempo synchronization to enable networked musical performance.¹⁹⁵ Network latency in data transfer and between Internet servers, in the acoustic realm, soon leads to irritations in "social" musicking; that is why the individual players are provided with system clocks. This temporal infrastructure allows for synchronization, via satellite, across unconnected devices in spite of their local diversity.

191 See Niklas Luhmann, *Gleichzeitigkeit und Synchronisation*, in: ders., *Soziologische Aufklärung 5: Konstruktivistische Perspektiven*, Opladen (Westdeutscher Verlag) 1990, 95-130

192 Clemens Apprich, *The Never-Ending Network: A Repetitive and (thus) Differentiating Concept of our Time*, in: Kristoffer Gansing / Inga Luchs (eds.), *The Eternal Network: The Ends and Becomings of Network Culture*, Amsterdam (Institute of Network Cultures) / Berlin (transmediale e. V.) 2020, 25-32 (27)

193 See Alexander R. Galloway, *Protocol: How Control Exists after Decentralization*, Cambridge, Mass. (MIT Press) 2004

194 In Fritz Heider's sense: *Thing and Medium*, in: idem, *On Perception, Event Structure, and Psychological Environment. Selected Papers [Psychological Issues, vol. 1, no. 3 (Monograph)]*, New York (International Universities Press) 1959, 1-35

195 Reid Oda / Rebecca Fiebrink (2016), *The Global Metronome: Absolute Tempo Sync For Networked Musical Performance*, http://www.nime.org/proceedings/2016/nime2016_paper0006.pdf (accessed 4 June, 2018)

There is a nonhuman communication of temporalities when machines exclusively communicate with machines. The Global Positioning Systems calculates a position in space as a triangulation of signal runtime differences; space is hereby becoming a function of time-critical signal communication, like with the ultra-sonic echo location of the optical focus in automated Polaroid cameras, and with binaural human orientation in space already. But another schizo-chronicity opens: In accordance with relativity theory, "[t]ime passes more quickly for the satellites upon which GPS is dependent than airplanes and cars because they are further from the mass of the Earth. This leads to difference in determining the location of a machine on the surface of the planet and how it is calculated by the satellite. [...] these differences in temporal frames of reference add up to an error rate of about 10km a day. [...] In order to bridge this difference in rhythms in time, a temporal path must be constructed through the compensations of the clock"¹⁹⁶, which curved time.

The Internet is not only a stage for the bringing-together of different places as global "synchronisation" (Boris Beaudé¹⁹⁷), but like libraries before, this neologism evokes as its equivalent "synchronization", too. The very term "synchronization" expresses the arbitrary, techno-logical enforcement of temporal actions. Its antonym is "heterochronicity".

As it has been predicted by Michel Foucault, the present epoch is, above all, the epoch of space and simultaneity as its contemporary condition: "[w]e are in the epoch of juxtaposition, the epoch of the near and far, of the side-by-side, of the dispersed. We are at a moment [...] when our experience of the world is less that of a long life developing through time than that of a network that connects points [...]. The site is defined by relations of proximity between points or elements; formally, we can describe these relations as series, trees, or grids."¹⁹⁸

P. S. Disruptive Heterochronoi, and Techno-Traumatic Media Time

Once human senses are cybernetically coupled to technological agencies, they become subject to a nonhuman, alien temporality and media *eigentimes*. From the rupture between the human experience (interface phenomenology) and what actually occurs within the media

196 Bryant 2014: 168 (with reference to astronomer Richard Pogge)

197 As quoted in the Louise Drulhe's *Critical Atlas of the Internet* (2015), on display in the exhibition *The Eternal Network*, 28 January - 1 March, 2020, Haus der Kulturen der Welt, Berlin

198 Michel Foucault, *Of Other Spaces: Utopias and Heterotopias*, translated by Jay Miskowiec from the French version ("Des Espace Autres", published in: *Architecture / Mouvement / Continuité*, October 1984), in: *Diacritics*, Spring 1986, 22-26; quoted here from the online version <http://web.mit.edu/allanmc/www/foucault1.pdf>, accessed 12 February, 2019

"subface" temporality (Nake), a cognitive dissonance arises, a techno-traumatic irritation.

As long as devices, such as the Smart Phone, are simply (and literally) "ready-to-hand" (Heidegger), human users are usually unaware of this coupling. As it has been remarked in Walter Benjamin's "Work of Art" essay, the apparatus-free reality which is seen by the camera lens is in fact completely absorbed by its technical imaging. This correlates with the temporal experience of reality. The "vulgar" technological time regime becomes "present-at hand" (Heidegger) only in moments of error, of disturbance, or break-down (Heidegger, *Sein und Zeit*).

Against the media-archaeological investigation into the "inner time consciousness" *within* technologies themselves¹⁹⁹, media phenomenology deals with the irritations, which are induced by alien media temporalities, against the human sense of time. Such a case is the installations of an interactive holographic Holocaust witness to enable a speech-recognition based "dialogue" beyond his grave, as it is by the New Dimensions in Testimony program by the USC Shoah Foundation and the University of South Carolina in Los Angeles. It is software here, which selects and projects prerecorded video clips of the survivor in response to questions presented by an interlocutor²⁰⁰, and efficient real-time computing, which renders the illusion of a "live" presence. Beyond a simple "digitization" of audio-visual testimonies that have been recorded on analog audio, or video tape before (such as the Fortunoff Video Archive of Survivors of the Holocaust at Yale University), this memory is algorithmicized, and a kind of ELIZAfic(a)ton - a reactualization of Josef Weizenbaum's seminal first computer chatbot from 1966. In the case of the hologrammed survivor Pinchas Gutter, his "'testimony' is based on statistical probability, its media temporality being microprocessual rather than chronological" (Pinchevski 2019: 97). Thereby, the historical dimension is replaced by genuine media-time phenomenology.

Whereas the "weak" interpretation sees this as a kind of "mediatized" trauma, which is simply a dislocation of traumatic memory experience into another medium (Pinchevski), the rigid techno-traumata hypothesis assumes that the real trauma, here, derives from the technology itself, which challenges the human trust in "real presence" by real-time simulation. What once started with the phonographic choque of the disembodied voice, now recurs with a kind of Turing test. But for a generation of mobile media-born natives, which in Berlin bars, late at night, does not look for the presence of other guest any more, but rather checks constantly incoming e-mails and twitter messages from their

199 In a reversal of Edmund Husserl, On the phenomenology of the consciousness of internal time (1893-1917), transl. John Barnett Brough, Dordrecht (Kluwer Academic Publishers) 1991

200 Amit Pinchevski, Transmitted Wounds. Media and the Mediation of Trauma, Oxford 2019, 20

online smart phone, there is no logocentrism any more, a privilegization of the present, which can be traumatized at all.

TECHNOLOGY AND THE ATEMPORAL

Part I: echnology, and / or "Time"

"Time is not" (Heidegger)

"Time" does not exist in media as an emphatic perceptual parameter, neither does it relate to the symbolical narrative order, or cultural imaginary, named "history". Technology knows actual operations only, which is the tempoReal, even if disguised in computational terms like real-time.²⁰¹ "Time" literally *counts* within technologies in the conceptual, but not in the operational sense. There is no "time" within media; its cultural semantics is therefore replaced by the concept of temporalities.

The Einstein Center Chronoi (Berlin) investigates "time and related aspects such as awareness of time, time management, time reckoning and temporality"²⁰². But with notions like "temporal diversity" or "multitemporality" which "reveals itself in the coexistence not only of different local times, but also of different functional times and different time narratives"²⁰³, this approach still assumes a given "time" base. With its focus on the morphology and syntax of time, this is still a logocentric approach, while radical media archaeology suspends the supposition of "time" itself, to let another terminology unfold from within technologies.

In conventional (media-)cultural analysis, like in science, no understanding of technology, be it analog or digital, is complete "unless we possess a proper analysis of its appropriate time-concept"²⁰⁴. Any media event has, so far, been interpreted as a function of time signals. The philosophical question of how being relates to time needs to be specified in the question of media tempor(e)alities. Media archaeology not only replaces the ontological question "*what* is media time" by the focus on technology *in being*, that is: "*how* is media time", but more radically asks in terms of process-oriented ontology: Is there a sense of time within technical, and / or logical (therefore: technological) objects at all? Electromechanic and fully electronic media are therefore defined as a processual mode of existence as such.

201 See Friedrich Kittler, *Real Time Analysis and Time Axis Manipulation* [GO 1990], transl. and introduced by Geoffrey Winthrop-Young, in: *Cultural Politics*, vol. 13, issue 1, 13 March 2017, 1-18

202 <https://www.ec-chronoi.de/about>, accessed June 29, 2020

203 <https://www.ec-chronoi.de/about>, accessed June 29, 2020

204 Norbert Wiener, "Time, Communication, and the Nervous System", in *Annals of the New York Academy of Sciences*, vol. 50, 1948 / 50, pp. 197-219 (p. 197).

Technologies, if not reduced to pure matter and energy but understood as their reasonable, negentropic manipulation, are not simply in physical time, they are themselves *timing*. In time-critical (rather than simple "time-based") processes, a multitude of operational figurations is at work. While the temporal axis t is an abstract parameter, which is externally applied, there is actual *chronopoiesis* within technologies, which challenges the transcendent notion of a coherent "time" itself.

The analogy to the phenomenal "flow" of time, in electronics, is the integration of current *via* capacitors and transistors. Such integration is said, in engineering, to be a signal function "over time" as its parameter. But in $f(t)$, the "time axis" is a supposition, simply a diagrammatic form of plotting signals in n sequential steps - a heuristic hypothesis to make processuality countable, to adjust technical processuality (in the physical "real") to the symbolic order, to understand its events in cultural terms.

In Heidegger's words "[t]ime is not. There is, It gives time. The giving that gives time is determined by denying and withholding nearness."²⁰⁵ In terms of temporealities, technological machinery has no concept of time, but a sensing of dissipative events within controlled structures. Techno*lógos* though, different from Heidegger's concept of Being, does not become revealed in time. Technologies are not simply subject to thermodynamical entropy, but consist of *momenta* like the sudden, the delayed, the unfolded. In that sense, an application of Heidegger to technology becomes more concrete: "*The time* is meaningless; time is temporal."²⁰⁶

Any "phenomenology of the consciousness of internal time" is opposed to time-critical (in its literal sense) media science.²⁰⁷ In his *Der Ursprung des Kunstwerks*, Martin Heidegger (just as in his "Time of the World Picture") criticizes the scientific approach to nature as being based on the numerical measurement and analytics. In phenomenological terms, "time" rather refers to the philosophy of mind than to technological action, just like the subjective impression of colours is incompatible (even incommensurable) with its corresponding wave length in the electromagnetic "light" spectrum. The Fourier Transform of colour into the frequencies and amplitudes of its partial light waves (spectral analysis), understood as sine and cosine function, misses its essential

205 Martin Heidegger, *Time and Being*, in: idem., *On Time and Being*, trans. Joan Stambaugh (Chicago: University of Chicago Press, 2002), 16

206 "*Die Zeit* is sinnlos; Zeit ist zeitlich." Martin Heidegger, *Der Begriff der Zeit* [lecture 1924], Tübingen 1989, 26; transl. W. E. See Mike Sandbothe, *Die Verzeitlichung der Zeit*, Darmstadt (Wissenschaftliche Buchgesellschaft) 1998

207 Friedrich Kittler, *Phänomenologie versus Medienwissenschaft*, *online* available under <http://hydra.humanities.uci.edu/kittler/istambul.html>, accessed xxx

"shining".²⁰⁸ Technical analysis knows no "colour", neither knows it "time", but rather translates signals from the "time" domain into the frequency domain, which is the condition for its processing within computing.

From its digital resynthesis, user interface phenomena like colour result, but these are nothing but simulacra of its physical equivalent. In analogy, the only think which the mechanical does not know is "time", since this category is an effect on humans from the machine-diverted clock face. In the age of the scientific approach to nature, time is not treated as a transcendent signified any more, as a "given", but turns out as a function of multiple measuring of otherwise stochastically distributed events that are transformed into "data". In its cultural sense, "time" is nothing but a semantic abstraction of entropy, and the objective "time axis" a Newtonian construction of mathematical reason. Time axis manipulation²⁰⁹ is therefore no violence against an temporal truth, but time turns out as an effect (or phenomenal affect) of *timing operations*. The Time Base Corrector, and Temporal Rate Conversion, in electronic video editing, by intermediary storage and delay of its single signals, allows to synchronize the lines into a coherent "image" again (which makes sense to humans only). If the time base can be corrected, it is from no-time that such a technological device operates. Against the phenomenological, that is: anthropocentric concept of a "flow of time" (the Bergsonian *durée*), Latin *tempus* is connected with old Greek *themenein* which is the incision, the cut into a continuum; a similar meaning derives from German and English *Zeit* resp. *time*. "Time" therefore comes into existence by discrete distinction (clocking or pulsation) only, as it has been defined by Aristotle's book IV on *Physics*. The semantics of "time" is a derivate of a differential cut, by a technical operation (or cultural technique) which antecedes its metaphysical notion. "Time" comes into existence only by human cognition, but not within the machine.

The equivalent to a mechanism where different artefacts from the past do not simply coexist but are entangled in the moment of operation (technology in being) is digital computing in terms of the Turing machine with its reading and writing of a discretely back- and forward moving tape with inscribed symbols. One of Bergson's pictures of subjective life-time experience is the thread "unrolling of a spool" on the one hand, and "a continual winding, like that of a thread into a ball, for our past follows us, becoming larger and larger with the present it picks up on its way"²¹⁰.

208 In: idem, Holzwege, 4th ed. Frankfurt / M. 1963, 35 f.

209 See Friedrich Kittler, Real Time Analysis, Time Axis Manipulation, in: idem, Draculas Vermächtnis. Technische Schriften, Leipzig (Reclam) 1993, 182-209, and Sybille Krämer, The Cultural Techniques of Time Axis Manipulation: On Friedrich Kittler's Conception of Media, trans. Geoffrey Winthrop-Young, Theory, Culture, and Society, vol. 23 (2006), 93-109

Is the present "passing between the spools"²¹¹? The recordings accumulated on one spool, when analyzed and becoming conscious as an overlaying of the threat, presents a kind of material Fourier Analysis of the past. But at a moment when Martin Heidegger focused on this image of Bergson, in his 1928 *The Metaphysical Foundations of Logic*²¹², this metaphor had become electromagnet reality with the reel-to-reel wire recorder, and Samuel Beckett's one act play *Krapp's Last Tape* (1958) made the tape recorder loops a concretization of a personal recollection. "Recording, editing, and playback techniques [...] all bring the past into contact with movement and change in the present"²¹³. And Bergson immediately withdraws his metaphor: "To tell the truth, it is neither a winding nor an unwinding, for these two images invoke the representation of lines or surfaces whose parts are homogeneous to and superposable on one another. No, no two moments are identical in a conscious being" (Bergson, op. cit.).

While for Husserl, a "time object" such as a melody unfolds in human cognition, this phenomenological impression is substituted, or reified, in phonography when such a recording on a rotating wax cylinder, or disc on a rotating table, has to be mechanically moved in order to unfold as "melodic" at all.

Microanalytic Deconstruction of Media "Time"

The "time" concept makes sense for the Newtonian physical experience at the level of human day-to-day, or cultural "historical" perception, but "at the level of the very small and very fast, it seems as if there is a new set of rules - a different kind of physics"²¹⁴.

Radical media archaeological analysis not only returns the collective singular "time" by a plurality of "times", but replaces this term by the plasticity of more precise and epistemologically enriching terms which media engineering itself offers for so-called temporal events, such as the "time filter", the "time relay", or the "time sampler" (such as the magnetic tape-based Springer Tempophone).

210 Henri Bergson, Introduction into Metaphysics, in: idem, *The Creative Mind. An introduction into metaphysics* [1946], Mineola, N. Y. (Dover) 2007, 133-169 (137)

211 Barker 2012, chap. "Deleuze's Time and Serres' Multi-temporality", 59, referring to Henri Bergson's *The Creative Mind*.

212 See The Stanford Encyclopedia of Philosophy, entry "Henri Bergson" (*First published Tue May 18, 2004; substantive revision Wed May 27, 2020*), <https://plato.stanford.edu/entries/bergson> (accessed July 5, 2020)

213 Barker 2012: 60

214 Geoffrey C. Bowker, Life at the Femtosecond, in: Volmar / Stine (eds.), chap. 6

The piezoelectric "delay line" in signal transmission, in electronic television (system Phase Alternating Line), serves to synchronize the colour components. But such a Δt transforms into a different processuality once it is microscopically analyzed as a series of sub-temporal events. In "digital" electronics, the digital dissolves into electron flows when closely examined on the semi-conducting silicon crystal level.²¹⁵ A core technological element for Norbert Wiener's cybernetic communication analysis is the vacuum electron tube, which - in its formulation as cross-related triode (flip-flop circuit) - has been used as binary switching agency in electronic computing. But in microscopic analysis, it turns out as a cloud of speedy electrons which disseminate rather stochastically than in full symbolic control. "Treating time as discrete means nothing other than switching. [...] Strictly speaking, there are not discrete machines because in an analogue period of time everything moves continuously" (692). It is the material - rather than simply logical - implementation of the switch which enables digital computing. Switching is an operation which pre-conditions "the recurring syntagmatization of time, namely through timing [*Taktung*], or, more precisely, the discretization of time."²¹⁶ When hardware becomes programmable, it is its resistance which does not fully subject matter to *lógos*. "Time"-discreteness is the symbolic effort to subject this *hindrance* to a logocentric concept. But "[e]ven the expression 'time' proves to be inadequate and misleading considering the fact that the switch is what provides a difference-giving absolute difference - the quintessence of the medial - a real home, which is what then leads to a treatment of time as discrete."²¹⁷

Operational *topoi* which are generally subsumed under "time-based" media such as *time-division multiplexing* undo with "time" once they are more precisely described, in this case as "[m]ultichannel transmission of continuous input signals in sampled (digitized) form whereby the samples from individual channels are transmitted sequentially over a common transmission link."²¹⁸ The production of "sequentiality" is a rather mechanical operation which is in physical time by its energy consumption and thereby increasing entropy (just like in quantum state measurement), but *as technology* is a-temporal like the clock which is giving symbolical time, but not in symbolical time itself.

215 See Stefan Hóltgen, Hertz aus Glas. Silicium als Medium in den Medien, in: Margarate Vóhringer / Christof Windgáetter (eds), Glas. Materielle Kultur zwischen Zeigen und Verbergen, Bielefeld (transcript), forthcoming

216 Anna Tuschling, Historical, technological and medial a priori: on the belatedness of media, in: Cultural Studies vol. 30, no. 4 (2016), 680-703 (691)referring to Friedrich Kittler, Hardware. Das unbekante Wesen, in: Sybille Krämer (Hg.), Medien - Computer - Realität, Frankfurt / M. (Suhrkamp) 1998, 119-132 (127)

217 Tuschling 2016: 693

218 Edward B. Magrab / Donald S. Blomquist, The Measurement of Time-Varying Phenomena, New York et al. (Wiley) 1971, 320

The "temporal" is a question of scaling. While the unidirectional "time" arrow (thermodynamic Boltzmann entropy) arises from "distant reading" of molecular movements in terms of statistical mechanics, it dissolves into random distribution when inspected closely. Informational (Shannon) entropy is timeless in its ergodicity, as a challenge to "narrative" in computer gaming.²¹⁹

[The measure of entropy for information, according to Shannon's definition, is a logarithmic function of alternatives. Different from Wiener's "time of non-reality", the duration of a binary decision as a direct effect of the number of alternative choices literally "counts", when it comes to highly integrated electronics. "With more alternatives, the level of uncertainty increases, which leads to a delay in reaction time."²²⁰]

Once technical "time" processed are well-defined, the temporal dimension becomes too general an abstraction which dissolves into concrete processes and movements. "Time comparison" turns out as "the process of indicating the amplitude of a waveform at a given instant"²²¹ which defines the temporal moment as an arbitrary *datum*.

Media "time" analysis takes place between the "natural" (entropic) world and symbolically ordered (negentropic) culture.²²² It is physical matter and energy structured, or even coded, by the symbolical machine. Time, in that sense, is no natural property but comes in as a cultural construct, an human scientific effort to measure physical events objectively. Temporal units like Planck time (*tp*) "eliminate anthropocentric arbitrariness from the system of units, unlike the meter and second, which exist for purely historical reasons and are not derived from nature"²²³. It is related to the speed of light it takes for a change of state, which pushes the question whether quantum time is continuous, or discrete, to the limit. Such an occurrence itself does not necessarily have to be subsumed under "time" as parameter. But as quantum event, and

219 See Espen Aarseth, *Aporia of Epiphany in Doom and The Speaking Clock. The Temporality of Ergodic Art*, in: Marie-Laure Ryan (Hg.), *Cyberspace Textuality. Computer Technology and Literary Theory*, Bloomington / Indianapolis 1999, 31-42

220 Florian Sprenger, *Intervals of Intervention: Micro-Decisions and the Temporal Autonomy of Self-Driving Cars*, in: Volmar / Stine (eds.), chap. 8

221 Britton Chance et al. (eds.), *Electronic Time Measurements*, New York / Toronto / London (McGraw-Hill) 1949, 528

222 For the definition of culture as "negentropic", see Vilém Flusser, *Kommunikologie*, ed. Stefan Bollmann / Edith Flusser, Frankfurt / M. (Fischer) 1998

223 Entry "What is Planck Time?", website *Universe Today*, <https://www.universetoday.com/79418/planck-time>, accessed June 11, 2020

except from quantum computing itself, it falls below the bandwidth of what - at least currently - is the *technological* media field.

Two time regimes clash within technologies. A "time discriminator" is a pleonasm, since the semantics of transcendent time itself is a function of discrimination, of making a difference (in Spencer-Brown's terms): "A circuit which indicates the time equality of two events of the sense and approximate magnitude of the inequality."²²⁴ The "sense" of time here turns out as a function of comparative measurement from within technologies. And the definition of "time modulation" as a core operation in "analog" sound and image transmission, as well as in "digital" pulse transmission, reveals the double-bind of "time-based" media processes to an internal (physically real) and external (symbolically measured) time axis: "Modulation in which the time of appearance of a definite portion of a waveform, measured with respect to a reference time, is varied in accordance with a signal."²²⁵ The mentioned waveform itself is a replacement for "time" here: "A current of voltage considered as a function of time in a rectangular coordinate system" (ibid.). It is rather the symbolical analysis, as "consideration", which turns the electronic event into a "time" signal.

[In cybernetics, automata provided with sense organs, and effectors, are "the equivalent of a nervous system to integrate the transfer of information from the one to the other."²²⁶ Still, they lack a sense of time (unless by description in phenomenological terms). "[T]hey can be subsumed under one theory with the mechanisms of physiology.. The relation of these mechanisms to time demands careful study" (ibid.) indeed - including the hypothesis of "time" itself. In both systems, the relation between input and output of signals "is a consecutive one in time and involves a definite past-future order" (ibid.), but to call this past and future "in time" is already a phenomenologization of the internal machinery. "What is perhaps not so clear is that the theory of the sensitive automata is a statistical one. We are scarcely ever interested in the performance of a communication-engineering machine for a single input. To function adequately, it must give a satisfactory performance for a whole class of inputs, and this means a statistically satisfactory performance for the class of input which it is statistically expected to receive" (ibid.) - a different kind of "time", since its theory rather belongs to the Gibbsian statistical mechanics than to the classical Newtonian mechanics. "Thus the modern automaton exists in the same sort of Bergsonian time as the living organism [...]. Vitalism has won to the extent that even mechanisms correspond to the time-structure of vitalism; but [...] this victory is a complete defeat, for [...] the new mechanics is fully as mechanistic as the old" (Wiener 1948: 56.) Where

224 Chance et al. 1949: 528

225 Chance et al. 1949: 528

226 Wiener 1948: 55

materialism has come to be a loose synonym for mechanism, the metaphysics of "time" does not make sense any more.

Not only the opposition between mechanically reversible and entropically unidirectional time has been sublated in information theory: "If the seventeenth and early eighteenth centuries are the age of clocks, and the later eighteenth and the nineteenth centuries constitute the age of steam engines, the present time is the age of communication and control."²²⁷ Such a synthesis unthinks "time" itself.

[Technologies come into their "media" being only in the moment of signal processing. But to map such states to the cultural construct of "time" confuses an analytic measuring approach with an understanding of this media-being.]

In technology, time as an abstraction of the symbolic order confronts the tempoReal of entropic mechanisms. "Media" is understood here as that branch of technology which transduces (analog), or processes (digital) signals not as transfer, or storage, of energy, for its own sake, but for directed communication. But even "communication" gets a more media-archaeological sense once it is liberated from human intentionality: "There is in electrical engineering a split which is known in Germany as the split between the technique of strong currents and the technique of weak currents, and which we know as the distinction between power and communication engineering. It is this split which separates the age just past from that in which we are now living. Actually, communication engineering can deal with currents of any size whatever and with the movement of engines powerful enough to swing massive gun turrets; what distinguishes it from power engineering is that its main interest is not economy of energy but the accurate reproduction of a signal."²²⁸]

For the analysis of "recursive" algorithms, up to "real-time" in data processing, as opposed to "live" broadcasting, "time" does not exist in media as a symbolical narrative order, or as imaginary "history", but as actual operations only, from the computational extensions of the window of the present, down to the tempoReal. "Time" does not count within technologies in the conceptual, but only in the operational sense. Therefore, there is no "time" within media; its cultural semantics is therefore replaced by the concept of temporealities.

In conventional (media-)cultural analysis, like in science, no understanding of technology, be it analog or digital, is complete "unless we possess a proper analysis of its appropriate time-concept"²²⁹. Any

227 Wiener 1948: 50

228 Wiener 1948: 50

229 Norbert Wiener, Time, Communication, and the Nervous System, in: Annals of the New York Academy of Sciences, vol. 50, 1948 / 50, pp. 197-219 (p. 197).

media event has, so far, been interpreted as a function of time signals. The philosophical question of how being relates to time needs to be extended and specified to the question of media tempor(e)alities.

There is agreement that there are inner-technical temporalities outside of the human sensory of temporal experience. "In computer time, even while all of these temporal scales interpenetrate, different configurations are being developed. But they are made of the same stuff as standard historical time."²³⁰

Media archaeology, going beyond, not only replaces the ontological question "*what* is media time" by the focus on technology *in being*, that is: "*how* is media time", but more radically asks in terms of process-oriented ontology: Human "pro- and retention" becomes almost simultaneous circuitry in electronics. With its distributed action-reaction, and input (sensor) / output (actor) chains, is there a sense of time within technical, and / or logical (therefore: technological) objects at all? Electromechanic and fully electronic media are thereby defined as a processual mode of existence as such.

Technologies are not simply in physical time, they are themselves *timing*.

"Time", as a noun, is an abstraction, suggesting substantiality. In English, though, there is as well the verb *to time, timing*" - and Heidegger dared to make use of the antiquates *zeitigen* in German language again. The same structure happens for "end" ("Ende"), leading to *ending* - a temporalization of "time" and "end" themselves

In time-critical (rather than simple "time-based") processes, a multitude of temporal figurations is at work, not just the temporal axis as an abstract parameter, but actual *chronopoiesis*. When the analytic focus is directed to time-critical processes, technologies do not simply happen within the physical parameter of time, but they challenge the transcendent notion of a coherent "time" itself.

Signals and Sensors instead of a Technical "Time Sense"

Media archaeology does not operate with cognitive abstractions like "sense" but seeks to ground (*arché*) and locate the precise techno-logical scenario where the micro-media drama occurs.

Implicit technological sensing occurs as a differential, dissipative tracing of physical or logical changes. Explicit technical sensing has the "sensor" as its media-theatrical stage. In its definition as signal transducer, the

²³⁰ Geoffrey C. Bowker, *Life at the Femtosecond*, in: Volmar / Stine (eds.), chap. 6

sensor is not about "time" at all. In electrical transducers, "signals are converted to and from other physical quantities (energy, force, torque, light, motion, position, etc.). [...] A sensor is a transducer that receives and responds to a signal or stimulus from a physical system. It produces a signal, which represents information about the system, which is used by some type of telemetry, information or control system"²³¹ - or chronometry, which results in the "time" function.

A video camera does not actually have a sense for the "time" of the moving image. Its difference between recording a still image (by dissolving it into successive scan lines) and between recording moving objects is simply the difference between differential equations of the first and the second order (in mathematical "logical" analysis), and between primary and secondary integration by circuitry of condensers and resistors (in electro"technical" materialization). The electronic camera transduces no "image-movement" (Deleuze) into current, since the moving "image" makes temporal sense to human perception only, not to the "senses" of the electrotechnical device.

Does the transduced signal preserve its former essence, or is it actually "transsubstantiated"? It still preserves its quality in a structural way, such as its wave form which can, from the human cognitive side, be conceptually experienced (or scientifically calculated) as "temporal" - opposed to its translation by digital sampling into something which can be conceptually treated as "time"-discrete.

The key agency here is the "signal". It is mostly defined as time-signal; in some definitions anything that is only a function of space, such as an image, is excluded from the category of signals.²³² Such micro-epistemic indeterminacies are a symptom that the technological being can not perfectly be squeezed into the categories of the Kantian *a priori* of time and space. It is in such moments of non-commensurability with human "temporal" cognition that a technological being radically articulates itself.

The function $s(t)$ may be analytically reversed. As a mathematical derivation, it ontologically refers to the same dynamic entity, but its "time" parameter is replaced by an equation. Logical "time", as a symbolic operation, here replaces the "real" techno-physical event.

In electronics and communication media, the signal refers to "any time varying voltage, current or electromagnetic wave that carries information."²³³ But in another, less anthropocentric language, a signal may more neutrally be defined "as an observable change" (ibid.), an analog quality which can be electronically transduced, or digital quantity,

231 <https://en.wikipedia.org/wiki/Transducer>, accessed June 12, 2020

232 <https://en.wikipedia.org/wiki/Signal>, accessed June 12, 2020

233 <https://en.wikipedia.org/wiki/Signal>, accessed June 12, 2020

which is a function of technical sampling. Only in digital signal processing, a signal is a function that, by abstraction in terms of mathematical communication theory (Shannon), "conveys information about a phenomenon" (ibid.). "A signal may or may not contain any information."²³⁴ But if any potential change is one of its latent potencies (as assumed by quantum physics), such a superimposition does not require "time" to be defined, nor "history" or "evolution" to unfold.

Demetaphorizing the "Time-Image" and the "Time Crystal"

Against the constructivist Aristotelian concept of *chrónos*, "time" in terms of phenomenology comprises the condition of the possibility of human subjectivity for Kant, Bergson and Husserl, which has been extended to the conceptual "time-image" by Deleuze.²³⁵ With films like Alain Resnais (1961) *Last year at Marienbad*, what Deleuze calls *l'image-temps* is "released from its subordination to movements linked with physical actions"²³⁶ into an ahistoric temporality. But even this cognitive delusion still grounds in the autonomous chronopoetics of the cinematographic mechanism, even more in the electronic video or TV image, which results from temporal one-line scanning itself.²³⁷ Cognitive "crystals of time", as identified by Deleuze²³⁸, metaphorically concretize different possibilities of the cognitive "time-image", different from the cinematographic (mechanical) "mouvement-image". Such an imaginary crystal, according to Deleuze, is one where "the smallest internal circuit" between the actual image and its virtual counterpart is encountered.²³⁹ When understood literally, this leads to an "internal sense of time" within electronic circuitry itself.

The time-"image" is released from human cognition by its mathematical understanding: The Laplace Transformation transforms a function of time $f(t)$ in an image function $F(p)$. The latter does not look like a time object at all, it reveals the non-temporal, it rather reveals the diagrammatic

234 Ibid., referring to: Pragnan Chakravorty, "What Is a Signal? [Lecture Notes],"IEEE Signal Processing Magazine, vol. 35, no. 5, pp. 175-177, Sept. 2018

235 Gilles Deleuze, *Cinema 2: The time-image*, trans. H. Tomlinson / R. Galeta, New York (Continuum) 2005. See as well Bert Olivier, Deleuze's "crystals of time", human subjectivity and social history, in: *Phronimon*, vol. 17, no. 1 (2016)

<http://dx.doi.org/10.17159/2413-3086/2016/160>, accessed June 18, 2020

236 Nina Zimnik, "Give me a body". Deleuze' Time Image and the Taxonomy of the Body in the Work of Gabriele Leidloff", in: *Enculturation*, May issue 1998, <http://www.uta.edu/enculturation>

237 See Maurizio Lazzarato, *Videophilosophie. Zeitwahrnehmung im Postfordismus*, Berlin (b-books) 2002

238 See David Norman Rodowick, *Gilles Deleuze's Time Machine*, Durham 1997

239 Olivier 2016, referring to Deleuze 2005: 68

essence of time functions.

As it becomes apparent in computational morphing, the machine is indifferent to the sequential variety of processing the data. It does not compare such operations against an abstract mathematical Newtonian "time", but varies according to its inherent "algorhythmic" (Miyazaki).

When in picture telegraphy, and electronic television, a two-dimensional image is one line-scanned for teletransmission²⁴⁰, such a sequentialization (as expressed in the Latin meaning of the "second") is literally a transfer function, a *timing* of spatial objects in purely functional terms, and as a technical trick (*mechané*, in ancient Greek) by no means related to the emphatic semantics of "time".

"Time-crystals" are less metaphorical in terms of (quantum) physics which discovers crystals that are not ordered as self-repeating patterns (symmetries) in space, but periodically repeat in time - a different kind of phase transition, as it is known from continuous sine waves, or discrete pendulum clocks.²⁴¹ The controlled behaviour of electrons in silicon crystals, as the semi-conducting condition for electronics in computing, becomes a different one once their physical medium itself is temporalized. But for the creation of such time crystals, like in traditional wave mechanics or wave electronics, an external clocking as energetic excitation is required, like the vacuum tube as oscillator²⁴², or micro waves, like laser light pulses. This is technologically induced physical nature, or "medianature" (Jussi Parikka). *Timing* here dissolves into arbitrary entanglements of energy and matter.

What Quantum Physics has to say about Technical "Time": Temporal Diffraction, and the Apparatus (Barad)

The "arrow of time", which has been physically justified by the second law of thermodynamics, is symbolically suspended²⁴³ by information theory in its negentropic formulation, and mathematically treated as statistical distribution. According to Birkhoff's ergodic theorem and Gibbs' equivalence between time averages and averages over the ensemble,

240 See Gustav Eichhorn, *Wetterfunk - Bildfunk - Television (Drahtloses Fernsehen)*, Leipzig / Berlin (Teubner) 1926, Reprint Wiesbaden (Springer Fachmedien), 31

241 See Frank Wilczek, *Zeitkristalle*, in: *Spektrum der Wissenschaft* 6.20, 12-19; [spektrum.de/artikel/1725062](https://www.spektrum.de/artikel/1725062), accessed June 16, 2020; same author, *Quantum time crystals*, in: *Physical Review Letters*, vol. 109 (2012), and *idem / A. Shapere, Classical time crystals*, in: *ibid.*

242 See Heinrich Barkhausen, *Schwingungslehre*, xxx

243 See John Durham Peters, *The Suspension of Irreversibility: The Fundamental (and Futile) Task of Media*, in: Volmar / Stine (eds.), chap. 1, forthcoming

there are sequences of events where the statistical distribution of its elements (be it molecules, or communication units) do not vary from second to second. "A family of messages with such invariance is said to be a *time series in statistical equilibrium*. In such a system, this shift of the zero of time generates a group of transformations preserving the distribution functions unaltered [...]." ²⁴⁴

It has been Boltzmann's statistics which introduced temporal determinacy into thermodynamic physical processes and thereby justified the cultural, sometimes religious notion of a one-dimensional time arrow, and the irreversibility of time. But this "time" is a function of mathematical equations, just like James Clark Maxwell discovered the "speed" of light from his mathematical analysis of Michael Faraday's technical experiments on electro-magnetic induction.

Technical measuring is transducing signals by sensors, just like photography (in Herschel's astronomy) was the term for measuring light. Different from the time-reversible Newtonian mechanism of the stars (and quantum microphysics), where t can be exchanged with $-t$, their observation by photography irreversibly changes the light-sensitive chemistry, in accordance with unidirectional thermodynamic entropy. ²⁴⁵ Finally, quantum physical observation turns every measurement into an irreversible process.

The quantum-theoretical insight into the entanglement of the observing apparatus and the observed physical object or process has already had an increased epistemic impact on media theories. Now it is starting to redefine the relation of technologies to "time" itself. Time is no objective measuring unit.

The question of "time", in quantum theory, does not relate to the analysis of temporality in media technology in its immediate sense. But media theory and quantum physics literally "correlate" in the moment when the technical apparatus becomes the precondition of quantum-mechanical analysis itself, since the entanglement of the observed physical world with the observing technical apparatus cannot be decoupled. The Aristotelean hypothesis that "time" comes into being only by the numerical measuring of movement (without respect to the "before", or "after", though) is most concrete here.

The "uncertainty equation" in quantum theory becomes a media-theoretical question once it refers to the entanglement of measuring apparatus and the observed event.

²⁴⁴ Norbert Wiener, Time, Communication, and the Nervous Systems, in: Annals of the New York Academy of Sciences 50 (1948), 197-220 (204)

²⁴⁵ See Norbert Wiener, Cybernetics, or Control and Communication in the Animal and the Machine, Paris (Hermann) / Cambridge, Mass. (The Technology Press) / New York (Wiley) 1948, 44

In media-theoretical terms, there is not "time" in technological processuality, but "patterns of differencing", a pre-emptive material, and energetic simultaneity of machinic elements and their (re-)configurations.

In analogy to the double-slit experimental apparatus which is known for the spatial analysis of quantum effects (the wave-particle equation), Karen Barad presented a similar device to prove "time diffraction": the occurrence of several temporal moments at one time²⁴⁶

Quantum physics knows "time diffraction" (Barad) in opposition to the linear unfolding of an absolute sequential time. There is not only spatial, but also temporal diffraction. The superposition of times can be detected - or rather, it is generated as "time" - again by a technical apparatus: the rotating disc with slits, through which laser beams pass electrons, as known from the Nipkow disc in early electro-mechanical television, and Denis Gabor's cinematographic slicing of "acoustic quanta", related to some kind of time indeterminacy principle. At a given moment in time (and place), multiple times go through the slit. Space and time are inter-actively produced here in an entanglement of times, called "space-time mattering" by Barad.

[Time compression as media operation is practiced in cinematography by Martin Reinhard's *tx-Transform* which implements the Slitscan recording technique reversing the time- and the space-axis (like an "explosion" diagram of a technical artefact)²⁴⁷, and Kamel Utterbach's temporal interaction with the computer screen, on display at Ars Electronica in Linz xxx. And in Hiroshi Sugimoto's classic long-time photographic exposure of classic film theatre screens, finally all the projected images merge into one bright light - "an extreme condensation of time."²⁴⁸]

The concept of time in quantum theory oscillates between physics and metaphysics. According to Nils Bohr, before measurement, there is no "there" there - and no "time" either

The double-slit experiment allows to physically change the past: the decision takes place *after* the event. Such a past is yet to come, not just

246 Karen Barad, *Troubling Time/s, Undoing the Future*, talk given June 2, 2016 at The School of Culture and Society, Aarhus University, Futures Lecture Series; <https://www.youtube.com/watch?v=dBnOJioYNHU>, accessed 5 April 2020, min. 22:40 - 24:16 (special thanks to Eva-Maria Nyckel & Thomas Nyckel for this hint)

247 *tx-transform* is the title of a short film produced by Martin Reinhart with Virgil Widrich (35 mm, Austria 1998)

248 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)

left behind. When even erasures leave traces in the world, it is not matter or energy, rather information that counts for "time".²⁴⁹ In the concept of temporal diffractions, the slide enacts a path, and a sum, over all possible histories (reminding of Leibniz' thought experiment *apokatastasis panton*; and recalling the ergodic theorem in physics). But even this kind of chrono-analysis still adheres to the cognitive assumption of a temporal *a priori*, to the cultural semantics of "time" and "history".

Part II: Computational Non-Time:

Technological Indeterminacy vs. Time-Critical Analysis

"[T]he notion of computability is intermingled with the notion of time - that is, constructive time versus pseudo time."²⁵⁰ The epistemic aesthetics of "indeterminacy" turns out as a reaction-formation in the cultural unconscious against the universal deterministic machinery of clock-time and digital computing. It has been reminded, in that context, that the Turing machine has no sense of ending indeed. Still, the *halting problem* (within the Turing machine computability), as well as the currently fashionable discussion of the unpredictable in algorithmic computing²⁵¹, should not be confused with "indeterminacy", allowing for a speculative media aesthetics, not binding to its sound technological and computational knowledge. Against the somewhat "distant reading" of the temporal and its relationship with digital technologies, as invoked by the philosophy of Deleuze, media-archaeological advancement of thought is closely "grounded" in technological analysis.

"Time" as a function of number and movement

Techno-epistemological media studies are concerned with dynamics, with the essential processuality that is inherent to all operative media. Artful ("technical" in its original Greek sense) operations are the technological equivalent to human "performance" (such as dance). Therefore a media analyst is sensitive to questions of movement and their counting, to which the Aristotelean definition of "time" itself refers: the effect of numerical measurement of movement.

249 See Ernst von Weizsäcker (ed.), *Offene Systeme I. Beiträge zur Zeitstruktur von Information, Entropie und Evolution*, Stuttgart (Klett) 1974

250 David Gauthier, *To Execute, Rewrite, and Debug: On the Construction and Deconstruction of Computation*, doctoral thesis at the Faculty of Humanities, Amsterdam University, 2020, 35

251 Such as Beatrice Fazi, *Contingent Computation: Abstraction, Experience, and Indeterminacy in Computational Aesthetics*, London (Rowman & Littlefield) 2018

What is actually "revealed" by measuring? A thermometer does not measure external, but rather its own temperature. What refers to "temperature" here, equally refers to "time" as well, once it is defined as a function of numerically measuring movement. The Geiger counter sonifies the radio-active decay of atoms not for measuring "time", but is closer to physical entropy than any mechanical clock.²⁵²

The "digitalisation" (as arithmetisation) of movement is always already implied when it comes to so-called time-based arts. If "time" is defined like this, the essential mathematicity of technological processuality is implicit: *touto gar estin ho chronos, arithmos kineseos kata to proteron kai hysteron.*²⁵³ Even stand-still thus turns out to be a temporal form (the interval).

Against the anthropocentric "sense of time" (St. Augustin's *Confessions*, Bergson's notion of *durée*) the only working definition of "time" which is relevant to technological media analysis is its functional, operative Aristotelean definition. The tachistoscope in nineteenth century physiology made human nervous reaction measurable. Only from the measuring apparatus such "time" (or *temps perdu*, in Hermann von Helmholtz' term²⁵⁴) arises.

Computing does not adhere to a universal "time", but exists as a chrono-technical, autonomous cosmos of its own. Even if a computer receives input from humans by Human-Machine interfaces, or from the physical environment by sensors, the signals are immediately sampled into discrete voltage values ("bits") and are thereby suspended from worldly temporality in favour of an inherent media materiality. The distribution of "time" within a computer (clocking) derives from a clock-like mechanism, the piezo-electric quartz oscillator, but is immediately transformed into asynchronous timing. The concept of data flow in computing allows for every modular process to finish at its own pace.

[The correlation to such discrete "clocking" in the world of analog communication media has been - and still is - the generation of undamped electromagnetic HF carrier waves by electronic oscillators for the "wireless" transmission of modulated low-frequency signals like speech, and music. In mathematics, the "analytic" signal is exactly defined at each discrete moment in time.²⁵⁵ Analogue radio or television

252 See Georg Spehr, Funktionale Klänge. Mehr als ein Ping, in: Sound Studies. Traditionen, Methoden, Desiderate, ed. Holger Schulze, Bielefeld (transcript) 2008, 185-208

253 Aristotle, Physics, book IV (219b 1-2)

254 See Henning Schmidgen, xxx

255 See Timothy Scott Barker, Time and the Digital. Connecting Technology, Aesthetics, and a process Philosophy of Time, Hannover, New Hampshire (Darmouth College Press) 2012; idem, Against Transmission: Media Philosophy and the Engineering of Time, London et al. (Bloomsbury) 2018

are "analytic media" only once their variable signals are decomposed into periodic sine waves by Fourier Analysis.]

"Internal" time consciousness is a phenomenological construct. Time in culture is a symbolical order, organized in discourse predominantly as narrative "history". Time in physics is an absolute parameter (Newton) or relative observable (Einstein), and in terms of quantum theory time is always intertwined with the space dimension. Media-archaeological analysis oscillates between both poles, since technology is an encounter of the symbolical cultural order (*lógos* / reason) with the material real (physics). Microelectronics operates in the intervall between Newtonian mechanics and quantum electron behaviour. As an intertwining of the symbolical machine with the material real (as is has been described by Norbert Wiener's *Cybernetics* from 1948 in his chapter on "Newtonian and Bergsonian Time"), events which occur on this micro-electronic level are rather autonomous against temporal entropy. Technical micro-temporeality (or the technological tempoReal) is, in that sense, not referring to emphatic "time" at all. When the measuring apparatus itself interferes with its objects of observation, which is a core theorem of indeterminacy in quantum physics, this still does not subject the question of media temporality to physical science.

In terms of technical media analysis time is not treated as a transcendent given, but as a function operations like measuring and counting, therefore: timing media. Time, as an effect of symbolically counting real processes, is a patterning.²⁵⁶ The very term parameter (from the Ancient Greek παρά, para: "beside", "subsidiary"; and μέτρον, metron: "measure"²⁵⁷) remembers of this measuring media functionality.

Hindrance time

In the European Occident, clock-defined time has been introduced "bit by bit". This expression is more than just a word play. Abstract quantitative time, as a function of mechanized metrization, displaced the regime of qualitative religious time. An equivalent mechanistic dispositive has been the basis of chronophotography, "the technical measurement of the smallest temporal units in working processes in order to optimize production"²⁵⁸. Movement here is discretely measured not with a reference to transcendent time, but as operative quanta of the signal, derived from sequential shots acquired by the photographic apparatus arranged in sequence (Eadweard Muybridge) or in image superimposition (Étienne-Jules Marey). The Aristotelean definition of *chrónos* is replaced

²⁵⁶ See the chapter "Newtonian and Bergsonian Time", in: Wiener, *Cybernetics* 1948, on *Durchmusterung*

²⁵⁷ <https://en.wikipedia.org/wiki/Parameter>, accessed May 29, 2020

²⁵⁸ Henri Lefebvre, *Rhythmanalysis: Space, Time, and Everyday Life*, London / New York (Continuum) 2004, 73

by the mechanisms and a media-analytic episteme that does not require any inner sense of "time" at all. This elementarization (or alphabetization) of movement not only allowed for the analysis of stilled time, but as well for time series manipulation like speeding up, or slow motion, even the reversal of the direction of time. Physical entropy is replaced by the symbolical order, time is geometricized (chronophotography and film), or numericized (computing).²⁵⁹ This radical analytic technification of "time" has been disguised by its imaginary re-entry in diegetic film by Muybridge himself (his synthetic Zoopraxiskope) tentatively "giving us fragments of the world, fragments that could be expanded into stories, into dramas or jokes or fantasies"²⁶⁰.

In physics, subatomic particles have been registered by chronophotography of vapor trails in Wilson's cloud chambers since 1911.²⁶¹ In more recent particle detectors, photographs were replaced by digital signal processing, such as the Metatek system at CERN. The media-epistemic shift here is from registering microtemporal events which are otherwise inaccessible to human perception, to animation as a mathematical function. Digital animation "provides access to the real itself, which exceeds the human sense of time"²⁶² in an even more radical meaning: no sense of time at all.

What appears on the "analogue" clock face as a smooth temporal progression (unless indicated by second index) dissolves into "digital" machine counting from a media-archaeological perspective which is the implicit phenomenology of the clockwork itself. The metaphysics of a continuous time gets replaced by a model of discrete pulsing - which is not only a variance within cultural history, but also a media-induced epistemological transformation of "history" itself.

The impedance between the two poles of a switch is technically called *hindrance*. Its mechanical precursor is the escapement. Through the functioning of the escapement, time counts in binary form. What alphabetic writing accomplished for the phonetic stream of speech, the wheeled clock achieved for time: a radical individuation, a core of

259 See Bernhard Vief, Die Inflation der Igel. Versuch über die Medien, in: Derrick de Kerckhove / Martina Leeker / Kerstin Schmidt (eds.), McLuhan neu lesen. Kritische Analysen zu Medien und Kultur im 21. Jahrhundert, Berlin (transcript) 2008, 213-232, and Hartmut Winkler, Prozessieren. Die dritte, vernachlässigte Mediendefinition, Munich (Fink) 2015

260 Marta Braun, Picturing Time. The Work of Étienne-Jules Marey, Chicago / London (University of Chicago Press) 1994, 251

261 See C. T. R. Wilson, On a Method of Making Visible the Paths of Ionising Particles through a Gas, in: Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences, vol. 85 (1911), 285-288

262 Anthony Enns, Time-Critical Animation, in: Moritz Hiller / Stefan Höltgen (eds.), Archäographien. Aspekte einer Radikalen Medienarchäologie, Berlin (Schwabe) 2019, 315-221 (221)

occidental combinatory rationality. Ultimately, the sampling practice of signal engineering is at hand, in which individuation means the replacement of an infinity of consecutive values with a finite number of values. Such a quantification of values changes its temporal essence: "Between 0 and 1 there is no time. . . . It is the hindrance that gives the 'discretized' [*diskretisierte*] time."²⁶³ The tick of the clock originated in the monastic order returns in the time-discrete formation of digital computing. In the guiding principle of the so-called von Neumann-architecture for computers, commonly in use today, this sense of time is still operative. "One thing at a time, down to the last bit!"²⁶⁴

The crisis of "time" concerns the digital. Its elementary unit, the "bit", is time-critical not in a transcendent but operative sense. As has been remarked by Norbert Wiener on occasion of a discussion about the "digital" at the Macy conferences, there is a "time of non-reality" between the switching from zero to one. This time literally does not "count" in computing. Read against the Aristotelean definition of "time", it is rather a "reality of non-time" which turns out here. Like the intervals between seconds in a mechanical clock, what escapes countability, cannot be measured in terms of time. The term *temps perdu* itself, even if it 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 continuous human nerve signal runtime and latency²⁶⁵, which is time-critical nervous (re-)action in the subconscious.

In techno-mathematics, the discrete signal (as a function of the old European epistemology of alphabetic atomization of speech, according to McLuhan) is exactly defined at each discrete moment in time, and thereby is the core element of digital media temporality. But in electrotechnical reality, unless in discrete pulse sequences, the binary signal as a function of switching relays is only an extreme formation of the analogue.

The flip-side of micro-temporal computing: Tracing computational *technológos* in its actual implementations

263 Bernhard Siegert, *Passage des Digitalen. Zeichenpraktiken der neuzeitlichen Wissenschaften 1500-1900*, Berlin (Brinkmann & Bose) 2003, 9, referring to: Claude Elwood Shannon, *A Symbolic Analysis of Relay and Switching Circuits*, in: *Transactions American Institute of Electrical Engineers* vol. 57 (1938), 713-23

264 William Aspray and Arthur Burks, *Computer Architecture and Logical Design*, in: William Aspray / Arthur Burks (eds.), *Papers of John von Neumann on Computing and Computer Theory*, Cambridge, Mass. (MIT Press) 1987, 5 f.

265 See Henning Schmidgen, *Die Helmholtz-Kurven. Auf der Spur der verlorenen Zeit*, Berlin (Merve) 2009

Computational execution takes place *in* time only when observed from a parametric distance. Inertechnical operativity deconstructs its temporal abstraction by a set of *différences* where the Delta can do without its abstraction into *t*. One approach to the question whether there is a computational sense of time is to focus on its increasing clock rates. Such a micro-temporal analysis remains within the symbolical time regime. In reverse, Donald E. Knuth, in a keynote lecture to the 11th World Computer congress in 1989, proposed to "[m]ake a thorough analysis of everything your computer does during one second of computation."²⁶⁶ David Gauthier monitored and listed the single-step Linux kernel events during one second of his computer (between 12:30:37.178624843 and 12:30:38.163742036 on September 4, 2018) by application of a GNU debugger. The closer such events are observed, the more they are entangled with the material idiosyncracies of the electronic hardware. Temporal idiosyncracies become apparant which are materially and energetically contingent. Such a hardware-oriented "inner historicity" is revealed by "vagabonding along the lines of rotrubled signs and uncertain signals"²⁶⁷. The parametric temporal "second", actually implemented in the computing machine, dissolves into micro-reticular chains of operation and materially situated (rather than abstractly "time-based") "interims". The idealistic *inputation* of chrono-technically identical reproduction of periodic beats (iterative "time") is replaced by "itineration"²⁶⁸, which is the following media matter in its processual unfolding, its temporeality, with a focus on its actual operation instead of its subjugation to an abstracted time.

Counting is *imputing* "time" as a function of numerical measuring of movement, but the time-giving apparatus, the counter, is not provided with a sense of "time" itself. David Gauthier's sound art installation *Measure for Measure for Measure*²⁶⁹ addresses how traditional oceanic tide level measurements have been replaced by simulation (Lord Kelvin's analog computer) and predictive mathematical models. Earthly "tide" oscillation, with all its physical frictions no parametrical "time" base yet, are replaced by a techno-mathematical "time".

266 Donald E. Knuth, Theory and Practice, in: Theoretical Computer Science, vol. 90, no. 1 (1991), 1-15

267 David Gauthier, Iteration vs. Itineration: Theory and the GNU debugger, abstract of a paper presented in the Media Archaeology section (theme "Hands on Time: On Media Temporalities") during the MAGIS International Film Studies Spring School, Gorizia, March 23 to 26, 2019. See as well Gauthier's doctoral thesis: Executions, Rewrites & Debuggers: On the Endless Counstruction and Deconstruction of Computation, Amsterdam School for Cultural Analysis (ASCA), University of Amsterdam, 2020, chap. 6 "On Debugging"

268 Gauthier *ibid.*, referring to "itineration" as proposed in Deleue / Guattari, A Thousand Plateaus: Capitalism and Schizophrenia, Minneapolis (University of Minnesota Press) 1987)

269 Developed for the exhibition The New Observatory at FACT, Liverpool, summer 2017

While digital computing is in accordance with the Aristotelean definition of time as numerical counting of discrete changes (the symbolic machine as abstraction of physical signal processing), the electronic analog computer actually does not "count" at all but functions with the preemptive intuitive (rather than analytic) anticipation or pre-sensing (rather than "dissipation") of energetic (voltage) states themselves. The "analog" machine sense of signal circuitry and transduction is (almost, within the limits of electrophysical "drift") simultaneous ("change", or endurance), while its "digital" abstraction into counting is successive, therefore "temporal". Whereas a digital computer can only discretely mimic a continuous physical process by discrete computational means (unless such a physical process is micro-physically dissolves into the wave-particle-duality), the analog computer actually simulates it by a electro-physical analogies (voltages) according to a co-referential mathematical analysis (differential equation) which is the model for its physical programming by electronic hardware modules such as the operational amplifier. While in mathematical terms the process, by partial differentiation, is integrated "over time" (such as a movement from t_0 to t_1 , its implementation as analog computing in itself does not even "think" of the time parameter, since analog computers measure processes and signals continuously rather than "time-discretely" - no step-wise calculation, no algorithm, but a technological configuration in the physically real, that is: the domain of real numbers (not integers).²⁷⁰ This is not another time, but not "time" at all. Different from digital computing, the analog computer operates almost instantaneously, within the limits of light speed itself - in "acoustic space" (as termed by McLuhan). Only the electron drift in metal conductors causes minimal delay here - which, once more, substitutes the necessity for a temporal term (like "past") by an operation. If time is *not* computationally (or in medieval *computus*) treated as "discreet" (Turing), the very term does not make sense any more.

The "Y2K Problem" and the Computational (Non-)Sense of Chronological Time

In medieval monasteries around the first "millenium" (year 1000), *computus* has been the term for manual calendar calculation of the yearly religious Easter dates, in the sense of a mechanical data processing.²⁷¹ In the digital computer as well, the time stamp is purely symbolical. "At its basest level, digital evidence exists in a physical

270 See Stefan Hölltgen, *Mit dem Computer spielen. Analogien und Physiologien im Spiel mit der Spannung*, typescript 2020, referring to Bernd Ulmann, *Analogrechner. Wunderwerke der Technik. Grundlagen, Geschichte und Anwendung*, Munich (Oldenbourg) 2010. See as well Bernd Ulmann, *Analog and Hybrid Computer Programming*, Boston / Berlin (DeGruyter) 2020

271 See Arno Borst, *Computus*, xxx

medium such as magnetic disk, a copper wire, or a radio signal in the air."²⁷² Temporal forensic evidence, though, is subordinated to the symbolical regime, on a layer of abstraction. "Responding to a computer intrusion, a system administrator decided to make a backup of the contents of the disk using the standard backup facility on the system. This backup facility was outdated and had a flaw that caused it to change the times of the files on the disk before copying them. Thus, the date-time stamps of all files on the disk were changed to the current time, making it nearly impossible to create an accurate timeline of the offense."²⁷³ Just like human misreading and erroneous transcription of numerical time information, which may destroy the possibility for temporal reconstruction, for computing chronology, the "outdated" makes only sense in the symbolic time machine. Intruding programs may leave impressions on the altered system, but on the logical computer level such alterations can be eliminated. Only the microphysical traces of bit erasure are traces of "time" in the physical sense, since they increase entropy. Once more, there is an incommensurability between the physical temporality, and the logical regime of symbolical "time" administration.

At the turn of the recent millenium (year 2000), a computational problem led to a collective panic for postindustrial information society. The so-called "millennium bug" reminded information society of its very temporal being-to-death. Most computers so far had been programmed in such a way that the step into the 21st century - without laborious intervention - meant a jump back a century, so after the 31st of December 1999, the 1st January was indicated as the 1st January 1900. The reason for this lies hidden within the operating system, rather than in any concept of *deep time*. The jump "backwards" from 1999 to 1900 (in computational time) was no philosophical musing on the nature of "time", but naked chrono-technological reason, materially triggered by integrated circuits. The computer "time bomb" named the Y2K problem reminded the post-historical society drastically that its temporal order is no more a function of philosophy of history but of data storage economy. In the early years of digital computing memory and processing space had been the most precious commodity, so it made sense to reduce the register for dates to just two, not four units - therefore, e. g., "59" instead of "1959" (to refer to the author's birthday). Thus the Y2K-problem turned out to be a function of the technomathematical precondition (*l'archive* in Foucault's sense) to which the notion of a "beginning" and "end" is no temporal but computing function. Calculating - which does not make a difference between "temporal" and other data in the von Neumann architecture - makes previous human-cultural concepts of "time" increasingly obsolete. If this statements seems to fall back into a historicist notion of media temporality itself, this simply indicates how

272 Eoghan Casey, "Introduction", to: idem. (ed.), Handbook of Digital Forensics and Investigation, Cambridge Academic Press 2009, 1-17 (6)

273 Casey 2009: 10

difficult it is, even in media archaeology, to liberate oneself from temporal semantics. To achieve this, machine writing (a true media archaeography²⁷⁴) is mandatory.

A Technological Sense of Ending? Replacing the Temporal Future by Techno-Mathematical Anticipation

Technologies have no sense of the past, present, or future - even if disguised in signal storage and delayed transfer, in the computational *halting problem*, or the techno-mathematical prediction of targets. Departing from the *halting problem* in computer science, the epistemic question arises: Do Technologies have a Sense of Ending? The *halting problem* reveals the computational non-sense of finitude, which makes sense to human conceptualization only. Cybernetics knows "time" not in an culturally emphatic sense, but as time-critical ("real time" and "just in time") practices like the techno-mathematical anticipation of targets, and predictive algorithms. Internet temporality arises not from philosophical concern but from operative practices such as "time-to-live" and "ping-to-death". The Y2K Problem has reminded of the computational non-sense of chronologically progressive time. From that, a differential "temporality" has arisen. The conceptual "smearing" in global computer clock synchronization undermines discrete temporality as such.

Cybernetics defines both organic ("memory") and technical feedback loops (in machine learning) as self-adaption. "[T]he information received by the automaton need not be used at once but may be delayed or stored so as to become available at some future time. This is the analogue of memory."²⁷⁵ Against mechanical determinism, as long as the automaton is running, "its very rules of operation" - be it techno-mechanical, or symbolically algorithmic - "are susceptible to some change on the basis of the data which / have passed through its receptors in the past, and this is not unlike the process of learning"²⁷⁶. But such a "past" is nothing but a function of mechanic or algorithmic pre-programming and its actual implementation in electronic circuitry. "The machines [...] already exist as thermostats, automatic gyrocompass ship-steering systems, self-propelled missiles - especially such as seek their target - anti-aircraft fire-control systems, automatically controlled oil-cracking stills, ultra-rapid computing machines, and the like."²⁷⁷

Do task- and target-oriented computers, in order to be functionally usable, have a sense of ending? While the theory of computation denies

274 Moritz Hiller / Stefan Höltingen (eds.), Archäographien. Aspekte einer Radikalen Medienarchäologie, Berlin (Schwabe) 2019

275 Wiener 1948: 54

276 Wiener 1948: 54 f.

277 Wiener 1948: 55

that it can principally be decided in advance if a given algorithm, as numerical *procedure* (different from the continuous *process*), comes to an end at all, counting and time converge in actual computing. Clocked computation turns the computer into a chronopoet. The stored program computer, in its von Neumann stored-program architecture as coupling of computation and high frequency clocking²⁷⁸, is not simply a "time-based medium", but a time-generative agency itself. The loop as time figure in analog media differs from the iterative and recursive operations in digital programming. Computing is indifferent to the cultural conventions of the symbolical time order, as it became apparent in the "Y2K problem". Internet temporality with its "time-to-live" and "ping-to-death" signals, and in the concept of "temporal smearing", subjects time to *technológos*.²⁷⁹

There is a non-narrative, entropic "sense of ending" from within technology on the microphysical level which is the operative temporeality of electronic media.

The presentiment of finitude - the sensation of "being-to-death" in Heidegger's terminology²⁸⁰ - is not restricted to living organisms exclusively. For "analog" media, this relates to a linear sense of signals. From the beginning, the pick-up, once set into the phono-graphic groove, anticipates, and already apprehends its spiral ending on the record. Technically signal-transducing *matter* is provided with an inherent, implicit "sense of ending" of its processuality.

Even the escapement-controlled wheel-driven clock, though apparently being an autonomous "time piece", anticipates its own end of timing already, by the frictions of energy which are dissipated in the mechanical translation from the spring.²⁸¹ Suspended from the reference to a transcendent intuition of "time", a clock is simply a mechanism, transforming stored energy into step-wise movement, which can be synchronized with other circular (or rather elliptic) periodic movements like the revolution of stars. "[...] metaphysical intuition, although, one can achieve it only by means of material knowledge, is an entirely

278 John von Neumann, "First Draft of a Report on the EDVAC", University of Pennsylvania, Moore School of Electrical Engineering (June 30, 1945), reprinted in *IEEE Annals of the History of Computing*, vol. 15, no. 4 (1993), pp. 27-75.

279 See W. E., From "time-based media" to genuine media tempor(e)alities, in: Greta Plaitano / Simone Venturini / Paolo Villa (eds.), *Moving Pictures, Living Machines. Animation, Automation and the Imitation of Life in Cinema and Media*. FilmForum 2019, Udine (Mimesis) 2020, 199-204. This text is an extension, and media-archaeographical radicalization, of that version.

280 Martin Heidegger, *Being and Time* [GO 1927], Harper and Row, New York 1962.

281 See Isabelle Stengers (with Didier Gille), "Time and Representation", in idem, *Power and Invention. Situating Science*, University of Minnesota Press, Minneapolis / London 1997, pp. 177-212.

different thinkg from the summary of synthesis of this knowledge. It is as distinct from it as the motor impulsion is distinct from the path traced by the moving object, as the tension of the spring is distinct from the visible movements in the clock."²⁸² Bergson's vitalist notion of durational time is metaphysical in his sense of an *expérience intégrale* (ibid.) which is alien to the machine but becomes machinic if *integration* is understood in its techno-mathematical meaning, as a step-wise quantization. No longer "real time [...] eludes mathematical treatment"²⁸³. A footnote to Bergson's rejection of chronophotographical, therefore mechanized "time" is indicative: "What the cinematograph shows us in movement on the screen is the series of immobile views of the film; it is, of course, understood that what is projected on this screen, over and above these immobile views themselves, is the movement within the projector."²⁸⁴ Bergson simply (or unconsciously) ignores the inner-technical mechanism which transforms continuous reel movement into step-wise intermittance where the celluloid stripe is brought to a stillstand by the Geneva gear with its Maltese cross element, including a "time of non-reality" (Norbert Wiener) - or rather reality of non-time - actually passing and performing between the discrete states. The very name of the "Geneva drive" is indicative of its mechanical tempor(e)alization, "derived from the device's earliest application in mechanical watches"²⁸⁵. While philosophical intuitivism insists that the essence of time as *durée* is "masked" in movement and change²⁸⁶, from the rigid media-archaeological, technocentric point of view, duration is actually unrevealed as metaphysics by the cinematographical effect.

"The thought of every age is reflected in its technique"²⁸⁷, which is the historicist version of media studies. In media-archaeological reversal, the strong techno*lógos* hypothesis assumes that the time-concept of an epoch might be reshaped by its technological insight. The mechanical clock is an effort by the symbolic mechanistic order to exlude the entropic tempoReal: "A watch is nothing but a pocket orrery [Astrolab], moving by necessity as do the celestial spheres; and if friction and the dissipation of energy play a role in it, they are effects to be overcome, so that the resulting motion of the hands may be as periodic and regular as possible", as achieved by time engineering after the model of Huyghens and Newton. In navigation, "for the first time it was possible to compute longitudes" - as a function of time - "with a respectable precision"²⁸⁸.

282 Bergson 1946 / 2007: 169

283 Bergson 1946 / 2007: 3

284 Bergson 1946 / 2007: 217, note 1

285 Entry "Geneva drive", https://en.wikipedia.org/wiki/Geneva_drive, accessed July 24, 2020

286 Bergson, Introduction I: Growth of Truth. Retrograde Movement of the True, in: idem 1946 / 2007, 1-17 (5)

287 Wiener 1948: 49

288 Wiener 1948: 49

The mechanical clock roots in dissipative mechanism which confronts the symboical (discrete "time") with the entropic (tempo-)Real.

In Arthur Ganson's kinetic sculpture *Beholding the Big Bang*, which is currently on exhibit at the MIT Museum in Boston, the turning wheels "prehend" their final exhaustion, while delaying it. "The motor drives a series gears designed to reduce its input speed such that it will take 13.7 billion years to turn the final gear in the train, embedded in a concrete block, once. This is the estimated age of the universe."²⁸⁹

The electronic (analog) image on the television screen is "written" by the scanning finger of the cathode tube ray line by line. After such a line has been completed in 64 microseconds, a special sync-signal, indicates the cathode beam to jump back to write another successive line. A different kind of synchronisation impulse indicates the completion of whole image frame, to start anew. Such a mechanism is exempted from temporal succession, but simply counts.

Latin *finis* means spacetime already: both the spatial border and limit, as well as the temporal end, achievement, goal, or final aim. It has been 20th century *cybernetics*, which gave the notion of finitude an epistemological twist for both humans and machines, as expressed in Norbert Wiener's cultivation of a non-deterministic, still teleologically orientated theory of feed-back²⁹⁰, and Simondon has extended this mechanological approach to a non-historicist theory of the genesis of technical objects.

The "temporal" sense of infinity has been transfigured into a new chrono-technical form by Georg Cantor's transfinite mathematics. As symbolic machine, computation has not simply widened the temporal horizon, but suspended it. The existential anticipation of a future in the past, as *futurum exactum*, dramatically escalated within electronic computing, turning the philosophical debate on the essence of time from an ontology into an analysis of micro-operations which take place technologically. Western science, tied to the necessities of military weapon research, managed to cope even with destiny and unpredictability in mathematical terms: linear prediction by stochastic calculation and harmonic analysis, as it has been developed by Norbert Wiener. Linear prediction effectively means the anticipation of the past in the future. This *chrono-trope* has been developed as a techno-mathematical tool for anti-aircraft artillery in the Second World war, from the analogue computer (Vannevar Bush's Differential Analyzer) to the first electronic digital computers.

289 Ganson's website <https://www.arthurganson.com/beholding-the-big-bang>, last visit 25 February 2019.

290 Norbert Wiener, "Behaviour, Purpose, and Teleology, in Bulletin of Mathematical Biophysics, vol. 5 (1943), pp. 114-133.

In ballistics, the final destination of a projectile has been a function of mathematical calculation, giving rise to new methods. A missile requires an in-built "sense of ending" in order to arrive at its planned destination, such as with the German rocket in World War II and its pre-calculated trajectory. With the A4 (propaganda name "V2") rocket a further escalation happened: A self-correcting mechanism (kind of analog computer, the in-built "Mischgerät") was able to correct aberrations during the trajectory literally "on the fly", as a technomathematical sensorium of linear time. The end of the trajectory is the final hit of the missile which corresponds with its self-destruction. But still, the trajectory is planned by linear prediction. For such a calculated trajectory, "time" has become a metaphor - with the *metaphora* read literally, as "transfer", here.

To calculate an anticipated, techno-mathematically approximated future event *in real time*, transforms "temporality" into a commodity.²⁹¹ Such a mechano-mathematics has been applied in the Sperry T-6 anti-aircraft director. "The computer performed [...] *prediction*, or leading the target, modeled its motion and extrapolated it to some time in the future."²⁹² The figure of "time" here is the grammatical future-in-the-past, based on a feedback operation. The noun "time" has become too imprecise to catch such complicated calculations. When ballistic prediction is based on the calculation of feedback loops, it becomes autonomous in respect to the so-called human element. Where the human still perceives a temporal event, the machine knows chrono-technics.

With anticipatory targeting and predictive algorithms, which extend to product placement such as by Amazon today, the category of the "now" transforms into an augmented present.

Phenomenology, physiology, and linguistics know an extended window of the present which unfolds between pro- and retention. To relate this nervous signal mechanism, as a "temporal" horizon, to a transcendent signified "time" is already a cognitive semantization of such operations. While "primary retention" (Husserl) is already defined beyond the momentary "now", secondary retention is already a recollection from the past. Bernard Stiegler applies this figure of thought as "third retention" to recording and storage technologies which allow for time-shifted replay of the event.²⁹³ The "temporal" dimension hereby becomes a

291 See Eva-Maria Nyckel, *Ahead of Time: The Infrastructure of Amazon's Anticipatory Shipping Method*, forthcoming in Volmar / Stine (eds.), *Hardwired Temporalities*, chap. 14

292 David A. Mindell, *Between Human and Machine. Feedback, Control, and Computing before Cybernetics*, Johns Hopkins University Press, Baltimore / London 2004, 20

293 Bernard Stiegler, *Technics and Time*, vol. 2: *Disorientation*, trans. Stephen Barker, Stanford, CA (Stanford University Press) 2009

chronotechnical artefact and, in cybernetic reversal, reminds of the artefactual nature of "temporal" experience within the human itself.

Beyond the automatic data validation function which is commonly found in word processors and text editing interfaces for smartphone application, the human pro- and retentive mechanism of sentence-building, such as the backwards-correction of the meaning of a word, becomes techno-mathematical integration within the computing machine. A similar time operation has been described by Edmund Husserl, when he refers to the human capability to grasp a musical melody, which is a "temporal" horizon unfolding by echoic retention and preemptive protension of the ephemeral present moment.²⁹⁴ Such dynamics has become technomathematics in real-time computing indeed - which does not know any "melody" but is processing, and aware (so to say) of always just one bit at a time. While human perception remembers forms as temporal, technical memory is a function of atemporal storage. "The plasticity in the memory of machines is that of the medium, whereas in human memory it is the plasticity of the content itself."²⁹⁵

Time-Sensing in the Internet

The programming of communication media pays respect to the "time"-critical, that is: discretely differential question of data synchronisation. When a code is literally "run" by the machine, a so-called *profiler* finds out how long the machine takes for the respective operations.

Global virtual economy is run by so-called "time" servers of the Internet. Such computers *serve* "time" only in the phenomenological sense; their computational, techno-logical operations actually root in in media materiality and electric energy. "Entrepreneurial time distorters reminded us of the materiality of time in developing (in 2009) a super fast cable between Chicago and New York to gain 4 milliseconds in trading time."²⁹⁶ Such a "time" segment is purely operational.

In times of Internet protocols and UNIX-time McLuhan's thesis that the pace of electronic media changes the patterns of temporal perception deserves a closer reading. Time-critical processes take place in its most media-archaeological sense, that is: on the basic layer of bit transfer in the Internet. To reveal the time-critical *message* of the Internet use, a

294 Edmund Husserl, *On the phenomenology of the consciousness of internal time* (1893-1917), transl. John Barnett Brough, Dordrecht (Kluwer Academic) 1991

295 Simondon 2017: 137

296 Gary Genosko / Paul Hegarty, "Where Has Become of Time? Temporal Smearing and Media Theory", <https://semioticon.com/semiotix/2018/03/where-has-become-of-time-temporal-smearing-and-media-theory>, last visit 29 June 2018.

close look at time-critical operations on the physical and logistical level of the Internet is required, such as the "time-to-live" and "ping-to-death" in signal transmission as a time-critical challenge of internet logistics.

Similar to submarine echo detection by the active sonar, a time-critical mode is true for communication in the World Wide Web. The ICMP protocol operates on the basis of echo request and echo reply. The source computer sends small data packets of the type echo request to the destination computer. In case these packets reach their destination, it replies with the type echo reply; thus the data connection between two machines can be checked and disturbances be detected. Such control data can be misused by ping flooding. "Ping of death" stands for oversized data packets which may lead some TCP/IP stacks to collapse, destroying the machine configuration; the destination computer thus is so busy with answering that it can almost not be used for its proper tasks any more. In TCP/IP as fundamental network program, techniques of synchronisation meet a deadly economy of time. "Time to live" means that each data packet is assigned a given life span - the time-critical signature of the information age. Heidegger's notion of human "being-to-death" has found its equivalent in non-human media synchronization indeed.

In the topologies of Internet communication, the "ping" sonar signal has become metaphorical. "Ping of death" is the name for a test signal which does not get a reply from a server within a defined real-time window, based on a literal count-down.

Against an anthropocentric concept of technology, radical media archaeology assimilates to the *techológos* itself which does not exist in any transcendent time, but in chronopoietic immanence only.

Etymologically, German *Zeit* or Latin *tempus*, and ancient Greek *temnein*, not only means to cut but to stretch as well, therefore the operation of creating a dynamic interval²⁹⁷. Different from the despotic minute- or second-regulated industrial machine age, the concept of temporal "smearing" - such as Google's fractional distribution of the leap second (when necessary to synchronize Internet time with astronomical time) over a whole day to spare computing to be abruptly shocked by such an interpolation - appears like a more intuitive return of the human sense of time within computing.²⁹⁸ But under a "time lense", even

297 Entry "Tempus", <https://en.wiktionary.org/wiki/tempus>, last visit 28 October 2018.

298 See Isabell Otto, *Infrastructuring Leap Seconds: The Regime of Temporal Plurality in Digitally Networked Media*, chap. 5 in: in Axel Volmar / Kyle Stine (eds.), *Hardwired Temporalities. Media Infrastructures and the Politics of Digital Time*, *Recursions Series* (Series Editors: Jussi Parikka, Anna Tuschling, and Geoffrey Winthrop-Young), forthcoming Amsterdam (Amsterdam University Press), forthcoming

milliseconds are discrete time-critical units of digitized time, against which a Bergsonian *durée* appear as an illusion to humans - not to the computing machines.

A century ago, Bergson rejected the Aristotelian concept of countable, "mathematical" time indeed, and its technological embodiment, which has been chronophotography and cinematography, and now extends to "clocked" computing. In fact, Bergson's alternative notion of *durée* nowadays only phenomenally corresponds with high-frequency media as a technological apparent "plasticization of time's passage"²⁹⁹. Still this does not actually correlate with any drift or "flow" of "real" time, but still operates in computational real-time by imposing a distributed, even resonant strategy of granularization of seconds into milliseconds. This is still the chronotechnical sphere.

In global computing, the interpolation of fractions of a second into computational Internet time, adopts to the astronomical time. Are computational media therefore provided with a sense of time? Such dissipative, "distributed time" has been created by networked informatics.³⁰⁰

Google's sub-second smearing is a form of fractional dilation of each second. Itself occurring in irregular temporal intervals, the interpolation of leap seconds in Internet time as time-critical adjustment "looks like human intervention into 'real' time"³⁰¹. From a techno-constructivist (or Aristotelean) point of view, the notion of "time" itself is a metaphysical function of discretization, a numerical measuring of operations. Internet time is a symbolic, non-natural, "cultural" time regime already. In UTC Internet time, the concept of periodically interpolating a "leap second" for coordinating the Internet with the astronomical chronosphere is symptomatic of the insistence of the time-discrete turingmachine, which is the numerical message of digital computation below its apparent temporal content.

External human time experience by counting, and internal technical computing fall apart. "Processing time" is understood here in its double sense: not processing *in* time, but generating an alien (tempo-)reality.

299 Gary Genosko / Paul Hegarty, "Where Has Become of Time? Temporal Smearing and Media Theory", cit., referring to W. E., *Chronopoetics. The Temporal Being and Operativity of Technological Media*, transl. by Anthony Enns, Rowman & Littlefield, London / New York 2016.

300 See Fabio A. Schreiber, Is Time a Real Time? An Overview of Time Ontology in Informatics, in Wolfgang A. Halang and Alexander D. Stoyeno (eds.), *Real Time Computing*, NATO ASI Series, Series F: Computer and Information Systems 127 (1994)

301 Gary Genosko / Paul Hegarty, "Where Has Become of Time? Temporal Smearing and Media Theory", cit.

"The temporal organization of chronic time is actually intemporal."³⁰² Instead of correlating human and nonhuman time, the real dichotomy is between the human sense of "time" and "no-time" in nonhuman assemblages. "But what do they *experience*?"³⁰³ Such signal traffic is no media "sense" of time, but rather its reverse: strictly sequential counting results in "temporal" effects, reminding once more of Aristotle's definition of "time" as a function of numerical measuring of motion. In order to analyze such electro-motions, it is more precise to replace the semantics of "time" by its operative technical terms which engineers have articulated in abundance.

The restless generation of large quantities of temporally volatile signals and digitally pulsed micro-moments ("data" as temporal "givens"), through online connected sensors and samplers, "distributed across machine-to-machine communication, sensor circuits, and Internet of Things" <cfc>, has profoundly altered geotemporality. The pulse-modulated electromagnetic fields interlace the perceptual aprioris of space and time into techno-logical chronopoietics.

Whereas media phenomenology is focussed on questions of aesthetics and time consciousness, media archaeology is not simply pluralizing "time" into multi-temporality any more, but radical renounces "time" at all.

"Time" (from now on in quotation marks) itself becomes outmoded for the denomination of arithmet(r)icised and "algorhythmicised" technological operativity. But not only in terms of media-analytical precision, the cultural abstraction of a multitude of events, and movements, against a collective singular called "time", asks to be replaced by a different set of equations and technical terms. The epistemic allure is rather to turn this necessity into a virtue, inviting to discuss whether the emphatic reference to "time", which Kant still defined a necessary *a priori* for human world perception, with an increased cybernetic coupling of human perception to communication media, itself makes no sense for the posthuman any more.

Part III: Implicitly "Techno-Sonic" Tempor(e)alities

***Chronoi* in Music: pre-"temporal" practice as cultural techniques**

In its format called Explorations, the Berlin Einstein Center Chronoi hosts the research project "Audible Temporality. How Time is Structured in - and

302 Émile Benveniste, "Language and Human Experience," *Diogenes* 13, no. 51 (1965): 1-12 (6)

303 Bogost 2012: 10

through - Music"³⁰⁴. Time here oscillates between its concept of a given (music "in time"), and a generative giving of time by music. In terms of cultural techniques, music has been the performative field of experimenting (with) time, as a symbolic precursor (or substitute) for what has become operative reality in electronic timing.

Phenomenologically, time is experienced as motion or flux of events, processes, changes, movements, and actions, while it is reckoned (measured) in discrete units.³⁰⁵ The research approach of the Einstein Center Chronoi (Berlin) already substitutes the despotic reference to a transcendent "mega-theory of time" by the focus on "time-correlated phenomena" such as rhythm, dynamics, and synchronization.³⁰⁶ Within the frame of the Explorations format, the research project *Audible Temporality* remains significantly ambivalent, and undecided, in its subtitle: *How Time is Structured in—and through—Music*. In its music-archaeological approach, such research "investigates the ways time is understood in antiquity by reconstructing music ensembles and conducting tests using modern reproductions and replicas of selected ancient musical instruments from different regions, based on their supposed sound structures and historic performance contexts"³⁰⁷. "Time" itself becomes thereby historicized by assuming that "ways of understanding time in musical practice, including ritual acts, are reflected in how time is structured in and through music" (ibid.). A counter-analysis would ask: Is there still a need for a "time" concept as long as operative musical practices serve as alternative (or precursor) to such a category at all? Still, even musical archaeology presupposed "time" in its analytic retrospection: "Time as structured by means of music can be identified [...] in incorporated performative practices (music, theater and dance performances)" (ibid.). In analogy to the media-archaeological approach to technology the investigation how time is structured within music assumes that "musical meaning is established through the temporal connection (chronicity) of musical constituents with one another" (ibid.). So-called "time" thereby turns out as a function of practices which do not necessarily require to be called "temporal" (to avoid the anthropocentric point of view). As long as human analytic language is still heavily charged by temporal semantics, concepts like "chronicity" - like "temporeality" - serve as an intermediary substitute to approach this *other* of "time", which is not heterochronicity, or the other *of* "time", but an alternative equivalent *to* time itself. Chronicities such as synchrony and simultaneity characterize musical action, making it possible "to structure units of musical experience" (ibid.) like numerical measuring constitutes "time". But "audible temporality" becomes

304 <https://www.ec-chronoi.de/time-in-sound-and-music>, accessed June 29, 2020

305 See <https://www.ec-chronoi.de/about>, accessed June 29, 2020

306 <https://www.ec-chronoi.de/about>, accessed June 29, 2020

307 <https://www.ec-chronoi.de/time-in-sound-and-music>, accessed June 29, 2020

temporal only in human perception, not in the vibrational signal event as such.

In the operative installation of John Cage's composition for organ Organ²/ASLSP (As Slow as Possible) at Burchardi church in Halberstadt, Germany, every tone from the keyboard lasts for years until the next key is dramatically struck.³⁰⁸

Systematic musicology investigates "the cognitive processes underlying the structuring of time in music [...] through current neuroscientific research on cognitive mechanisms of (musical) anticipation, prediction and synchronization" (ibid.). "It is expected that a unit of musical-rhythmical experience, based on chronicity, will be identified" (ibid.) - which will result in a analogies to measured "time".

What media archaeology shares with the musicological approach, is its emphasis on the actual, re-generative cultural-technical practices which actually replace the need of a transcendent "time" concept. In this structural perspective, musical performative practices, in cultural "history", are an equivalent to technological operations - while the latter, at the same time, turns out as a radical difference in the escalation from cultural techniques ("musicality") to technology.

Sonic Signals, and the Authenticity of Endotechnical Events

The Berlin Ethnographic Museum contains a large collection of copper negatives of phonographic wax cylinders which early recordings for musical ethnography. For a non-destructive, non-invasive playback of these so-called "galvanos" the Society for Applied Informatics (GFal) in Berlin has developed a system using a hybrid combination of endoscopic image processing and a mechanical sensor. "Playback" has a double sense, in terms of re-sonifying sound recordings from the past, and as a purely technological procedure of signal processing where the time dimension is actually converted into a space dimension. This precisely measured sound track geometry can be converted "back" to acoustic *time* signals "that can be directly transferred to digital sound media"³⁰⁹ - which again transforms the time signal into a computational frequency domain. Neither the electro-physical tracing nor its sampling into digital data, and algorithmic processing to achieve a favourable signal-to-noise ratio, has an emphatic sense of the "pastness" of the signals since it can

308 See Sabine Groschup / Georg Weckwerth (eds.), (JC{639})#1-89, including a DVD version of the experimental film (JC{639}) by Sabine Groschup (A 2006 / 2012), Künstleredition 2013

309 Thomas Kessler / Susanne Ziegler, Direct Playback of Negatives of Historic Sound Cylinders, <https://books.ub.uni-heidelberg.de/arthistoricum/reader/download/265/265-17-77845-1-10-20170523.pdf>, accessed June 12, 2020, "Abstract"

as well be treated in terms of two-dimensional image analysis (and its related Fourier Transform). Below all "digital" abstraction, the actual electro-magnetic interferences are not related to an external time but unfold as a dynamics of its own. In Maxwell's mathematical equations this resulted in the discovery of its speed of light - which itself becomes "time" only when it is symbolically declared so, as a measure parameter.

The actual message of sound as physical, and / or technical "medium", is its temporality (Ernst 2016). But in a radically reverse perspective, "music" is not a real sonification of an imaginary "time", or its symbolic organization (score), but an alternative concept, and offers an old-European vocabulary to address so-called "time" in different terms - in analogy to the technical language of communication engineering today.

For counting movement, human cultural techniques have been applied. The musical meter and rhythm served as substitute time piece, until Huygens' pendulum, in combination with his mathematics of the "cycloid", surpassed human temporal intuition with its precision in terms of seconds.³¹⁰ At that moment of automatization, the sense of time itself is replaced by operative discretization which rather refers to mechanical kinematics than to counting "time".

In his seminal essay "... how time passes ...", Karlheinz Stockhausen initially defines music in the tradition of the old Greek *drama*, as order-relations within time ("in der Zeit"). This might be rephrased into "as time" as transitive events. Indeed, Stockhausen rushes to argue next, such a definition presupposes a concept of "time" itself. Humans hear alterations in the vibrational sonic field, and human perception differentiates here varying intervals between such changes, which Stockhausen calls "phases".³¹¹ "Time" is a conceptual hypothesis for humans to make sense of such sensations. But in a more recent edition of this text³¹², more technical footnotes were added which Georg Heike from the Institute for Phonetics and Communication Research at Bonn University has created in 1963. They explain, criticize, or correct Stockhausen's idiosyncratic formulations in audio-engineering terms. Note 3 criticizes the imprecision of Stockhausen's notion of "phase" and differentiates between phenomenal cognitive impression and exact measuring which requires a measuring unit (such as "time"), and a measuring device. It is not from the measuring apparatus, but only in its symbolization by application of a measuring unit that the intervals Stockhausen describes become "temporal" at all. In his conclusion (41),

310 See Berz 1993: 171 ff.

311 Karlheinz Stockhausen, ... wie die Zeit vergeht ..., in: Die Reihe. Information über serielle Musik, vol. 3, Vienna / Zurich / London (Universal Edition) 1957, 13-42 (13)

312 Revised and annotated version, in: Dieter Schnebel (Hg.), Karlheinz Stockhausen. Texte zur elektronischen und instrumentalen Musik, Bd. 1, Köln (DuMont) 1963, 99-139

Stockhausen claims a new type of instruments to allow for a musical composition, and play, in terms of polymorphous "temporal fields", by means of a band manual or equivalent devices - which is the electroacoustic synthesizer, and computational microsound synthesis, indeed (such as Iannis Xenakis' UPIC for graphical notation in real-time). But different from the human need to conceptualize such sonic events in terms of "time", such sound technologies do not ask for such a concept. The terminology of music (for the symbolic order) and sound analysis (for the real signal event) offers an alternative to the "time" language instead. Stockhausen's notion of noisy time ("Zeitgeräusch"), resulting from the flipping from punctual to stochastic sonic perception, is no more countable musical "time" but ergodic processes (Shannon 1948). "Music" does not simply unfold "in time", but "time" is a function of its operational intervals, which introduce discreteness into variances of movement.

Philosopher G. W. F. Hegel once describes the actual tone not in terms of "time" but as a temporality of its own: "a being which disappears while it is"³¹³. This corresponds with Heidegger's definition of human awareness of "being-to-death". Such an inherent sense of ending comes close to the physical definition of the damped signal. But with the technological development of the undamped oscillator, such a being-to-death loses all its philosophical "time" metaphysics in favour of negentropic signal control. An alternative translation comes closer to its technological incorporation: sound is "a disappearing of the reality as soon as it is"³¹⁴. This gets grounded in technology with Paul Virilio's "aesthetics of disappearance" as a function of transportation vehicles and telecommunication media. In terms of physical acoustics, as opposed to the phenomenology of hearing, there is no "tone" at all, but only a periodic function, which alters into frequencies by numerical measurement. Derived from ancient Greek *tónos* for "tension", its electric equivalent is continuous voltage. Only by counting, sound becomes time-discrete, therefore computable.

The "Acoustic Quantum" as a Challenge to "Time"

The operational autonomy of inner-technical signal processing from its external subsuming under "time" (between the pre- and the proto-temporal) becomes apparent in granular sound synthesis. The implicit signal "sonicity" and logical "musicality" of media events does not reside in any acoustic content but in its qualities as extensional signal ("time" in terms of phenomenology). "[I]t is our most elementary experience that

313 "ein Daseyn, das verschwindet, indem es ist": Georg Wilhelm Friedrich Hegel, *Enzyklopädie der philosophischen Wissenschaften im Grundrisse* [1830], Hamburg 1959, 369, as quoted in Kittler 1993: 182 (translation W. E.)

314 Hegel's *Philosophy of Mind*, translated by W. Wallace and A. V. Miller, Oxford (Clarendon) 2007, 194; see Kittler 2017: 5

sound has a time pattern as well as a frequency pattern."³¹⁵ Even human hearing thereby treats sound both as temporal, and computational event. Time and computing merge into one in hearing. But in techno-mathematical analysis, "[t]his duality of our sensations finds no expression either in the description of sound as a signal $s(t)$ in function of time, or in its representation by Fourier component $S(f)$. A mathematical description is wanted which *ab ovo* takes account of this duality", resulting in quantum theory-inspired notion of "the uncertainty relation between time and frequency" (ibid.). Gabor's epistemic object, the "acoustical quanta" as cells of sound, correlate Δt and Δf , where "time" itself becomes a function of a delay which is a media-technical pre-condition of "time", but not "time" in itself. "Time" is rather a conceptual construct to make sense of such processes. "This method of analysis contains 'time language' and 'frequency language' as special extreme cases" (592) - which thereby reveals "time" as an idealistic, logocentric vanishing point, as a transcendent imaginary of the symbolic order. The media-epistemic condition of sound synthesis - in terms of humans hearing - is the mathematical analysis of "subjective acoustics"³¹⁶. But the apparatus of hearing, the ear, itself transforms the time signals into the frequency domain, which is processed in the brain as pulse trains. The "time" dimension, even within human neurons, gets lost in favour of the frequency domain. Gabor therefore considers "both time and frequency as co-ordinates of sound, and see what meaning can be given to such a representation" (ibid.). Time, here, is a mathematical quantity, "introduced by the method of analysis"³¹⁷ for the sake of computability, which Gabor distinguishes from the "intrinsic features of the phenomenon" (ibid.). The notion of "sharply defined states" is an effect of analysis in terms of "integral numbers" (ibid.) and is therefore an epistemic idealization of the actual sonic event. The "time axis" therefore makes sense for media analysis, but not for analytic media themselves.

Occasional formulations of phenomenological intentionality like "the ear will hear"³¹⁸ are anthropocentric no more once such a mechanism is granted a techno/*lógos* of its own in scientific language. While for Kittler, "[t]echnical media [...] are defined by nothing else than their strategy of subverting low-frequency ranges by / being able to simulate them"³¹⁹, such as alphabetic writing as symbolical (speech) time-manipulation and analog signal recording as time axis manipulation in the real (phonography, video recording), the techno/*lógos* hypothesis grants such processes an (ex-) "temporal" ontology of its own. Indeed, it might be media-epistemologically productive, "though meaningless, to descend

315 Gabor 1947: 591

316 Gabor 1947: 591

317 Gabor 1947: 594

318 Gabor 1947: 592

319 Kittler 2017: 9 f.

even lower into the continuous current domain where the frequency approaches zero and there is no possibility of temporal delay [...]"³²⁰.

For the granular music approach, "sound is no longer conceived in terms of periodicity or repetition, as defined by the "classical" acoustic model of Helmholtz, but as a dynamic, energetic phenomenon. One of his important references, in this domain, is the work by physicist Ilya Prigogine [...]. This is the theory to which Vaggione is referring when he describes 'dissipative structures of sound energy'."³²¹

[„One might be inclined to think that sharply defined states, characterized by integral numbers, are peculiar to quantum phenomena, or at least that they require special mechanisms to imitate them classically, such as strings or membranes" (Gabor, 1947: 594). Even before the impact of "acoustic quanta", with its duality of wave and corpuscle, triggered a chain of composers of granular music like Iannis Xenakis³²², Gabor himself, "[n]ot content with mathematical theory, [...] constructed his own sound granulator, which could compress and expand the time scale of recorder sounds [...]"³²³. Technologically, analysis here flips to media synthesis. In his *9 Beet Stretch*, Leif Inge digitally stretches a recording of Beethoven's 9th Symphony over 24 hours, with no pitch-shifting. Human listening to such sound-technological time axis manipulation "oscillates between two temporalities, pure duration, and organised musical time"³²⁴. In computational real-time operations like time stretching, "time" is no longer the name for a symbolical measuring (numerical counting, or computation) of material and energetic changes of state, but in reverse is exchanged by the techno-active numerical synthesis (computing). Another composer in the field of the granular music paradigm, Barry Truax, thinks in terms of such an endo-technological move: "The technique I have found the most striking in the way it facilitates moving inside a sound is real-time granulation of sampled sounds. [...] A dramatic shift of the sound called 'time-stretching' is made possible with this technique. [...] This effect is used not merely to create drones, but to allow the inertimbral character of the sound to emerge and be observed, as if under microscope. [...]"³²⁵

320 Kittler 2017: 10

321 Horacio Vaggione, *Composition musicale et moyens informatiques : questions d'approche*, in: M. Solomos, A. Soulez, H. Vaggione, *Formel-informel : musique-philosophie*, Paris, L'Harmattan, 2003, 91-116 (102), as quoted in Solomos 2006

322 See Iannis Xenakis, *Elements of Stochastic Music* (1), in: *Gravesaner Blätter* no. 18 (1960), 84-105 (86 f.)

323 Makis Solomos. *The granular connection* (Xenakis, Vaggione, Di Scipio...). *Symposium The Creative and Scientific Legacies of Iannis Xenakis International Symposium*, 2006, Canada, note 25

324 Heloisa Amaral, *between speakers and splinters: how musical performance stages the archive*, ed. Kate Nialla Fayers-Kerr, script June 2020

So-called "time language" and "frequency language" are nothing but "special extreme cases" in Gabor's quantum analysis of the explicit "mechanism" of human hearing (Gabor 1947: 592). The "uncertainty relation between time and frequency" (ibid.), as known from quantum mechanics, reveals both categories as analytic abstractions, and logocentric idealizations of the actual event. Gabor's "Information Diagram" (Gabor 1947: 591, Fig. 1) which captures both Δt (the "mean epoch" of time) and Δf in mathematical terms becomes operative in the hearing mechanism and can therefore be simulated by an analogous technical apparatus. In reverse, such an apparatus only in approximation know extremes like the "time" and "frequency" domain. Gabor separates the mechanistic simulation of human hearing physiology by a set of physical resonators (Helmholtz) which can always only be tuned to a certain bandwidth (privileging the "timeless" Fourier Analysis approach) from the "non-mechanism" (593) of neuronal (cognitive) signal processing. Human hearing cannot be reduced to the "ear resonators" (ibid.). In accordance with the cybernetic paradigm, Gabor describes human sound perception in terms of electronics, as a "phenomenon of nervous conduction" (593), rather than by any metaphysical speculations of the mind. What is defined as "inner sense of time" in phenomenology which accounts for "musical" understanding, therefore turns out as the analytic function of the interlacing of the time and frequency regime which do not actually exist in a purely separable form.

Such a cybernetic terminology is a drastic reversal of philosophical phenomenology. Once the "inner sense of time" is identified in its mechanism, as it is demonstrated by Gabor's meticulous analysis of subjective hearing (since sonicity has a privileged affinity to the question of "time"), Heidegger's notion of being-towards-death, in which the proper quality of human existence is literally de-fined by its anticipated finitude, as well as Husserl's notions of re- and protention in the human perception of the present moment which transforms physiologically acoustic perception into a cognitive musical impression, can easily be reformulated as recursive and predictive neural action and therefore be computed by machinery as well, by-passing any reference to transcendent "time" at all.

"It must be understood, of course, that there is an important difference between an acoustical quantum as registered by a physical measuring instrument, and as registered by the ear."³²⁶ A sonic oscillation between 500 and 100 Hz requires an endurance of 10 milliseconds to be recognized by the human ear as sound at all, instead of noise. There is a

325 Barry Truax, Real-time granular synthesis with a digital signal processor, in: Computer Music Journal, vol. 12 n°2, 1988, 14-26, as quoted in Solomos 2006, note 32

326 Gabor 1947: 593

threshold for temporal (as implicitly sonic) experience within the human hearing apparatus, whereas to a technical sound generator, such a quantitative threshold makes no qualitative difference at all. It operates without temporal sensation itself. Media archaeology does not only look for cybernetic analogies or resonances between perception in the animal and the machine, but for decisive differences as well. Time itself makes a difference here.

After a sound signal has been *granulated* into segments (tiny wavelets, or "acoustic quanta" in Gabor's term), the sound can be modified. "The granulation algorithm then reassembles the grains in a new time order and microrhythm. The precise manner in which this occurs varies from program to program."³²⁷ Chronotechnical *poiesis* hereby replaces the semantically emphatic category of "time".

Dissolving Media "Time" into Grains

While "analogue" media like the phonograph, in their allowance for time axis manipulation (Kittler), still affirm the supposition of a parametrical time, granular synthesis (as it is familiar in computational audio processing) re-generates the temporal structure of digitized audio signals themselves by addressing individual sonic „grains“. The former "time signal" for which the audio signal is exemplary is translated into the computational domain, which treats time as symbolic. The computer knows counting and clocking, but no "time". "Treat time as discreet", Turing once advised for digital computing³²⁸, which thereby translates "time" back into its pre-temporal operativity. "Time", with computing, returns to its strict Aristotelean definition. Since the elementarization of speech into the symbols of the phonetic alphabet, and counting movement by numbers, an operative notion of "time" has replaced the ontological, or phenomenological, time concept.

Composer Iannis Xenakis' graph for the distribution in time of the string orchestra's pizzicati-glissandi in his composition *Pithoprakta* (1955-56) plots something *in symbolic (visually spatialized, diagrammatically inscribed) time*, for which the string events themselves, as periodic "timeless" events, have no sense.³²⁹

327 Curtis Roads, *Microsound*, Cambridge, Mass. 2004, 187 f.

328 State of the Art, xxx

329 See Makis Solomos, *The granular connection* (Xenakis, Vaggione, Di Scipio...), paper for the symposium *The Creative and Scientific Legacies of Iannis Xenakis*, 2006 in Kanada, Fig. 4;

https://pdfs.semanticscholar.org/eca2/ba9631a9a4aec1204351aad1b3c327ea88e4.pdf?_ga=2.222346651.1295010319.1591216841-1789829124.1582045484, accessed June 8, 2020

This extends to micro-*aisthesis* and subliminal time signal processing. Granular synthesis, in sound computation, allows for operations like time-stretching (keeping the tonal level unchanged) and voice transposition (by pitch-shifting in real-time).³³⁰ Pitch-shifting leaves the temporal structure unchanged. Morphings allows to fuse two different sound sources by applying digital granulation to both audio files. Such technosonics takes the place of what has been called "time-based media" itself.

An Alternative to "Time": Resonance

Even if not concretized in the magnetophone or in radio transmission, electro-magnetic communication media are implicitly sonic. One of its key devices, the "resonant circuit", is therefore appropriately named by a musical term. In technical communication, there are signal events that proceed through nonhuman perception while being imperceptible to humans unless they are user-interfaced. It is the resonant circuit, which in radio allows for technical reception, before it can become perceived by human ears through loudspeakers at all. The analog video camera, which is an electronic transducer of physical energy (light) into electrical impulses, "bears a closer original relation to the microphone than to the film camera"³³¹ - in analogy to the electro-chemical, and electro-mechanical transduction within human eyes and ears when communicated to the brain. The concept of interspecies communication has been extended by cybernetics to the animal *and* the machine (Wiener 1948). From that techno-structural equivalence result resonant frequencies in the mutual human and machinic perceptibilities. The actual medium message derives from microperceptions that occur beneath the threshold, and *massage*, the human consciousness.³³²

The electronic image - different from the photographic film still - is not simply a unit in (sequential) time, but - like a melody - "contains in itself a temporal extension"³³³. As an (only apparent) "time object" (Husserl), such kind of electronic media *resonates* with the human perceptual senses in a privileged way. its "temporal" equality, though, emanates from its equivalence in terms of mutual mathematical Fourier analysis (analog computing) rather than by a co-original being-in-"time".

Since Oersted and Faraday, the study of electromagnetism which is a *sine qua non* for contemporary communication media has triggered a media epistemology of its own. The conceptual "resonant interval" (McLuhan) describes media communication in the electro-magnetic field

330 See Miyazaki, 2009: 394 f.

331 Viola 1990: 44

332 See McLuhan / Quentin Fiore, *The Medium is the Massage*, xxx 1967

333 Edmund Husserl, *On the Phenomenology of the Consciousness of Internal Time (1893-1917)*, transl. John Barnett Brough, Dordrecht (Kluwer Academic Publishers) 1991, 24

(defined as "acoustic space") as instantaneous present. Sheldrake has extended this media temporality to the concept of an organism's "morphic resonance" with its own past.

Resonance is a media-operative alternative to the cultural semantics of emphatic "time". According to the concept of *sonicity*, the actual message of the sonic signal (beyond its manifest acoustic content) is its temporal form, which becomes most concrete in high-frequency technologies.³³⁴ For wireless analog media transmission, where the speed of electro-magnetic wave propagation is approximately the speed of light, McLuhan identified "an information environment that has basically an acoustic *structure*", since in such broadcasting, "information is simultaneous from all directions and this is the structure of hearing"³³⁵. What McLuhan calls "the aesthetics of the resonant intervals of acoustic space" (ibid.) is the equivalent to what humans experience as time.

McLuhan, when defining his notion of "resonant" acoustic space, refers to Minkowski's concept of spacetime (1908), Niels Bohr's discussion of electron transitions between stationary states within the atom as transcending the frame of space and time, Louis de Broglie's postulate that even matter was constituted by matter waves, and Linus Pauling's notion of the "resonant interval" (for the chemical bond).³³⁶

In physics, resonance names the implicitly sonic quality of a material formation to vibrate at certain frequencies of excitation. This extends to a systems' feedback in biological and technical cybernetics, and to "backpropagation" in artificial neural nets. This even refers to correspondences between present and the past in terms of the energy-matter continuum. Elements that have once interacted can respond to each other's motions thousands of years later (ibid.).

Sonic tempor(e)ality, as perceived by humans and expressed in musical terms, anticipated its technical concretization: "If we sense that the description of sympathetic vibration ["resonance"] bears some resemblance to radio broadcast, it is no coincidence, the same principle is at work"³³⁷, equiprimordially. Technical ensembles with equal *eigenfrequency* of electro-magnetic oscillations start to "resonate", as in the tuning of a radio sender and receiver. Such a genuine media operativity is autonomous against the semantic time domain, and rather performs a processuality of its own.

334 See W. E., *Sonic Time Machines. Explicit Sound, Sirenic Voices and Implicit Sonicity in Terms of Media Knowledge*, with a Preface by Liam Cole Young, Amsterdam (Amsterdam University Press), series *Recursions*, 2016

335 Letters of Marshall McLuhan, ed. Matie Molinaro et al, Oxford (Oxford UP) 1987, 466 (italics McLuhan)

336 Marshall McLuhan / Eric McLuhan, *Laws of Media*, xxx 1988, 45 f.

337 Viola 1990: 42

["As a science of action and repetition, cybernetics replaced diachronic materialism with the concept of synchronicity, which corresponds with McLuhan's notion of "acoustic space".

Not only natural, but artificial perceptual apparatuses nowadays "apprehend "tempi and intra-actions"³³⁸; machinic perceivers "communicate the history of their own operations through feedback loops" (ibid.). According to Rupert Sheldrake³³⁹, electron activity resonates with its own past patterns of activity, leading to a non-historicist, a-temporal continuity of "morphic resonance". Such a state is not ordered in "temporal" sequence, but its contemporary superimposition.

McLuhan's notion of the "resonant interval", borrowing from quantum mechanics and applied to the "temporal" ek-sistence of analog electronic media, becomes less metaphorical, and can be extended, to the digital computing regime.

The Bulova "Accutron", and resonant electronic synchronization

Media archaeology radically "grounds" an epistemic figure of processuality such as McLuhan's "resonant interval" or "resonance" itself in the concrete technological event. "Time" as a function of technical operations becomes most concrete in the sonic clock.

Resonance is not a "time" figure, but one of its media-epistemic alternatives.

A precisely oscillating tuning fork, inductively coupled to an electro-magnet (as it has been developed before by Hermann von Helmholtz as device to measure the micro-temporal run-time of nerve impulses), provides the time base in the Bulova *Accutron* watch (German "Stimmgabeluhr"). An early advertisement announced it as: "The Tick vs. the Hum". A sine tone here serves as time-giving media event - not for acoustical or even musical sake, but in implicit sonicity. It is the tempor(e)ality of sound which is shared by processual technologies

The core agency of synchronization is communication between nonlinear oscillators which adjust their rhythms due to weak interaction. Christiaan Huygens, in 17th century, observed the emerging synchronization of two pendulum clocks suspended in the same wooden beam. Their motions became "so much in agreement that they never receded the least bit from each other and the sound of each was always heard

338 From the "call for contribution"(May 2020) to an edited collection by Natasha Lushetich & Iain Campbell, *RESONANCE. Axiologies of Distributed Perception*

339 Rupert Sheldrake, *The Presence of the Past*, New York (Time Book) 1988

simultaneously"³⁴⁰. By such *coupling*, the implicit "sonicity" of synchronization (named "le phénomène de la sympathie, sympathie des horloges" by Huygens³⁴¹ becomes explicitly acoustic. "These features are typical not only of clocks, but also of many oscillating objects of diverse nature"³⁴² - kind of a generalized sonicity. "Mathematically, such an oscillator is described by an autonomous (i. e. without explicit time dependence) nonlinear dynamical system" (ibid.) - which means invariant in regard to "historical" or "cultural time", rather an *eigenzeit*. Beyond the acroamatic fixation of that time-critical phenomenon to the audible by human ears, the effect was applied by E. V. Appleton and B. Van der Pol to exact triggering of vacuum tube triode generators as basic condition of radio electronics. Soon afterwards, in 1920, W. H. Eccles and J. H. Vicent coupled to generators which had slightly different frequencies; the coupling actually forced the system to vibrate with a common frequency.³⁴³ Obviously, "the frequency of a generator can be entrained, or synchronized, by a weak external signal of a slightly different frequency" (ibid.). Such an *entrainment*, therefore, does not only concern the adaption of human neurons to musical rhythm.

But such a synchronization shall not be confused with this other phenomenon in oscillatory systems known as resonance: the response of a system that is non-active, i. e. demonstrates no oscillations without external driving, different from self-sustained oscillations without external forcing - such as the radio-controlled clock where the radio signal from the sender is meant only to adjust or correct the oscillations, vs. the railway station clock which actually stops when the electric impulse from the central master clock ceases.³⁴⁴

In chaotic multi-oscillatory systems, the occasional emergence of local synchronization can be observed on the oscilloscope: Lissajous figures for synchronous regimes, *versus* random distribution for the asynchronous regimes.³⁴⁵ This kind of strange attraction reminds of the Chua oscillator.³⁴⁶

Tuning fork-based electronic clocks are driven by frequencies within the audible range ("tonfrequent", 360 Hz /cps) - in reverse of philosophical or aesthetic speculations on "time and music". This chronotechnique ends

340 Horologium Oscillatorium, as quoted in: Michael Rosenblum / Arkady Pikovsky, Synchronization: from pendulum clocks to chaotic lasers and chemical oscillators, in: Contemporary Physics, vol. 44, no. 5 (September / October 2003), 401-416 (401)

341 As quoted ibid.

342 Rosenblum / Pikovsky 2003: 402

343 Rosenblum / Pikovsky: 402

344 Rosenblum / Pikovsky: 403

345 Rosenblum / Pikovsky: 406, fig. 4

346 T. Matsumoto, A chaotic attractor from Chua's circuit, in: IEEE Transactions on Circuits and Systems, 31/12 (1984), 1055-1058

with the subsequent Accutron 2 series with quartz crystals as *ultra*-sonic clocking device. But here is still sound, this time implicit, in the centre of this system: the piezoelectric *resonator*.

The crystal-based frequency standard is mandatory to coordinate, that is: synchronize complex communication networks, such as the American Telephone and Telegraph Company. National laboratories determine and maintain common standard frequency measurement units, exploiting novel piezoelectric quartz methods and electronic circuits. Exact frequency control is impossible without valve / transistor electronics. It has been Cady's discovery that quartz crystals display very sharp and stable electric resonance.³⁴⁷ Resonance, as expressed by the very *terminus technicus*, is implicit sonicity. The tempor(e)al of immediately coupled system arises when they are addressed in their *eigen*frequency. The resonant circuit (German "Schwingkreis") is the basis for wireless radio & television (and current mobile communication) devices. The Bell Labs searched for highly accurate methods for measuring oscillations as frequency rather than "time". The replacement of the despotic, transcendent signifier "time" by a plurality of alternative technical operations is already taking place, if only it is noticed by an underlying media-theoretical bias.

MICRO-ARCHIVING THE PRESENT. The Impact of Time-Critical Media Technologies

Instant recording: Archiving the present and re-presenting the past

Archiving the present in real time takes place in Web-based formats of radio and video. For so-called "streaming" media, the old metaphor for the flux of time dissimulates the radically bit-discrete character of buffering data and the time-consuming complex calculation.

Not only companies increasingly demand instant analysis of the present condition. Big data analytics, when conducted at a velocity approaching real time, already has an immediate effect on decisions being made online. Instant micro-archiving of the present is conceptually and technologically implied in the real-time processing of data, as a digital time-discrete sampling and quantizing of moments from the present signal - a punctualisation and mathematisation of the continuous event. This requires fractions of intermediary short-time storage of data. The concept of real-time communication, time-sharing and "interrupt" for

347 See Shaul Katzir, War and peacetime research in the road to crystal frequency control, in: Technology and Culture 51 (2010), 99-125
<http://humanities.tau.ac.il/segel/skatzir/files/2012/03/TC-Cady-published3.pdf>;

user input in computing dislocates the metaphysics of the pure present to micro-deferred presence.

A whole scale of micro-temporal "archiving presence" thereby unfolds, starting from ultra-short intermediary storage of electronic equivalents to zero and one in registers and flags, up to time axis manipulations after the digital sampling or recorded signals.

The media form of the analog present, for the longest time in 20th century, has been the notorious "live" transmission of signals by electromagnetic waves. By means of digital sampling, data compression and real-time computation (the "digital" equivalent to "live" transmission), news media manage to achieve the "live" effect even under digital conditions - a "post-digital" effect. But in news radio channels, glitches frequently betray that the audience is dealing with digital re-play. What appears like actual news broadcast, by mistake (when the news speaker activates the wrong icon on his digital control panel) a message which has just been spoken is repeated again. All of the sudden (and as a shock for the temporal authenticity contract between listener and radio station) it becomes apparent that there is not direct live transmission any more, but digital sound files sampled and stored on the sublime micro-level - a presence which is always "archived" already. The present event and storage merge into one with the temporally augmented digital.

Frequently the present moment has been considered as punctual: between the "not yet" and the "no more". The Aristotelean, that is: numerical time-definition (culminating in Zenon's paradox of capturing the flying arrow at a moment) is discrete, a kind of sampling the present by clocks which Heidegger denounced as even "vulgar" time. Leibniz and Newton develop the appropriate mathematical tool for infinitesimally approaching this volatile moment which thus becomes a chrono-epistemic *momentum*. Just like Henri Bergson already criticized chonography's "mathematical" sequencing of pure movement.

The proverbial photographic moment has always been a paradox: from the moment of the photographic click (which in itself, at close reading, is never punctual but a shrinking interval), the present is transformed into endurance. Analog archiving of the present is nowadays being matched by the "thickening of the present moment" in digital systems³⁴⁸ - a kind of micro-archival bubble.

With its instant digital recording, the present becomes immediately addressable and thus transforms into an implicit, sublime archival structure. By instant digital recording in real time, the present loses its

348 Timothy Barker, *Time and the Digital. Connecting Technology, Aesthetics, and a process Philosophy of Time*, Hannover, New Hampshire (Darmouth College Press) 2012, 194

metaphysical uniqueness before it even happens. The present no longer is granted time to take place, and instead is replaced by digital post-presence.

The temporalised cyborg, signal time and acoustic media archaeology

The media-archaeological approach does not historicize cybernetics to a mere chapter in the history of knowledge, but shares its enduring core assumption that from the *coupling* of human beings to techno(chrono)logical (artefacts), a specific experience of time results.

There is a specific alliance between the micro-patterns of auditory temporality³⁴⁹ on the phenomenological level and the processual being of technical media; the time-critical moments affect the most frequency-sensitive ("rhythmic") sense organ within the human which is hearing.

This has consequences for auditive re-presencing of the technically recorded past. If a movie projector is driven manually like in the vera early days, the visual perception is quite tolerant to slight temporal deviations. This is different with auditory signal replay.

Deconstructing the historical sense of time from within technological media

To what degree does the historicity of sound depend on its material embodiment? Phonographic "engraving" is sound in latency. The ontological status of recorded sound is waiting to be activated (German "in-Vollzug-Setzung"), to be "re-presenced" (a term coined by Vivian Sobchack in her analysis of media archaeology). Be it the analog reproduction of temporal wave forms or its digital reverse, the processing of atemporal mathematical frequencies, such "beeing-in-time" is not historical any more, but techno-logical. It requires the media-archaeological ears to understand such sonicity.

Is the sound of an existing Roman era bell dating from the third century a more ancient sound than the sound created by an equivalent bell from present time production, the media archaeologist Paul DeMarinis asks. "For this to be the case we would have to think of the bell itself as an encoding of some 'sound'; that sound, in turn, would have to include the splashing of the molten brass, the beating by smiths' hammers etc. But the sound the bell produces in its current use is far from being a

349 Don Ihde, *Listening and Voice. Phenomenologies of Sound* [*1976], Albany, NY (State University of New York) 2007, 87

recording of these sounds."; even if the bell stems from the past, its sounding is always present.³⁵⁰

[Bachofen's experience results in a more fundamental claim: "There are two roads to every kind of knowledge, the longer, slower, more laborious one of intellectual combination, and the shorter one, the one we cover with the energy and speed of electricity - the road of the imagination when it is touched by the sight and the immediate contact of ancient remains and grasps the truth in a flash, without any intermediate steps."³⁵¹]

A fundamental issue is at stake here: the need to de-couple the question of "temporality" from any narrative concept of temporal sequences which finally questions the notion of history itself.

Once our chrono-analysis is suspended from the historical discourse, a more radical challenge arises which is (among others) formulated in Timothy Scott Barker's book *Time and the Digital* as well: Is it possible to deal with micro-temporalities without mentioning the transcendent signifier "time" at all - in favour of a multitude of descriptive terms, a "field"?

"Time - today [...] - seems to reveal a new structure and to unfold in a rhythm that is different from the 'historical' time that governed the nineteenth- and the early-twentieth centuries. In this new chronotope - for which no name exists yet, even though we live within its forms - agency, certainty, and the historical progress [...] have faded into distant memory."³⁵²

Marshall McLuhan already had radically declared in a post-Hegelian mode: "Just as linear history begins with writing, it ends with TV"³⁵³. History depended on a cultural technique which is alphabetic, linear writing. The "writing" of images and texts on the cathode ray tube for television and computer monitors is of a different kind. Electronic media, therefore, are not just another variance in the history of technology but establish a new kind of temporal reality which escapes the concept of history.³⁵⁴

350 Paul DeMarinis, *According to Scripture* [*2002], in: Ingrid Beirer / Carsten Seiffarth / Sabine Himmelsbach (eds), *Paul deMarinis. Buried in Noise*, Heidelberg (Kehrer) 2010, 247-252 (247)

351 Quoted here after Gossman, *Orpheus*, xxx, 49

352 Hans Ulrich Gumbrecht, *After 1945. Latency as Origin of the Present*, Stanford, Cal. (Stanford University Press), 38

353 Marshall McLuhan, *Counterblast*, New York (Harcourt, Brace & World) 1969, 122, as quoted in Bexte 2008: 332

354 McLuhan 1969: 122

In contemporary society the pan-chronic horizon of temporal extension called "history" has been electronically condensed and algorithmically compressed into (or even replaced by) ever shrinking temporal intervals and a focus on the instantaneous present; close analysis of decisive temporal actions reveals the drama of time-critical media.

In techno-culture an augmented present unfolds, differentiated into a *media dramaturgy* of microtimes; the public radio and TV channels in Germany are even legally obliged to provide online access to a *Mediathek*, a library of broadcasts stored for a week. This is not an archive yet, but an extended window of the present.

"Liquefying" the archive

David Lynch's film *Inland Empire* which begins with the image of a spinning record on a record player. "As the needle drifts across the timeless surface of reified sounds, we are, once again, in the realm of mechanical reproduction and the logic of industrial time."³⁵⁵ The digital fragmentation of time, on the other hand, results in the loss of the chronology and directionality of time which becomes "[...] terrifyingly opaque and illegible for the human subject"³⁵⁶, resulting in a sublime micro-tempor(e)ality.

With the present as a function of rapid memory operations (both neurologically and digitally), the transformation of the traditional *tempaurality* of archival storage needs to be observed as well: from archival space to archival time, to the archival "field". Dynamic micro-media memories induce a cultural shift of emphasis from permanent storage to restless transfer. With the aesthetics of re:load, the technological affinity between the archival operation and cybernetics turns out, as manifest in feedback memory and timeshifting. Once these transformations have been analyzed, suspended memory results in total recall.

There are good reasons for questioning the static concept of an "archive" as appropriate term for digital record structures since as a metaphor it is increasingly becoming a hindrance for the analysis of dynamic data storage and circulation. The computer hard disc literally *moves* stored data in post-structural ways, just like the the magnetic tape did with recorded electronic signals (sound and video) before. The archive becomes *processual* in digital algorithms.

355 Zoltán Glück, *After Midnight, or: The Digital Logic of Time Fragmentation in Inland Empire*, in: *Munitionsfabrik 19* (2008), HfG Karlsruhe, 8-11

356 Glück 2008: 9

Archival endurance (with its records oscillating between symbolic code and physically entropical decay) is undermined when a record is not fixed any more in a permanent storage medium but techno-mathematical flow replaces the physical inscription.

[Sonic auscultation is an attempt to capture the volatility of sound and reveal its temporal message in a concrete manner through the algorithmic stethoscope, which is software for sound analysis.]

[The video artist Bill Viola in his essay on what he calls the *sound* of electronic images pointed out "the current shift from analogue's sequential waves to digital's recombinant codes" in technology.³⁵⁷ Sampling and quantizing of acoustic signals analytically transforms the time signal into the information of frequencies which is the condition for technical re-synthesis (Fourier transform). Digitalization means a radical transformation in the ontology of the sound record - from the physical signal to a matrix (chart, list) of its numerical values. Media culture turns from phonocentrism to processual mathematics.]

[The Technical Committee of the International Association of Sound Archives in her standard recommendations from December 2005 points out that any such rules of audio preservation need to be revised when changes of the technological conditions take place.³⁵⁸]

Digital operating systems need constant up-dating (in terms of software) and data "migration" requires appropriate hardware to embody them. From that derives a change from the ideal of archival eternity to permanent change - the dynarchive.

[When the transfer techniques of audio carriers changes from technically extended forms of writing such as analog phonography to calculation (digitization), this is not just another version of the materialities of cultural tradition, but a conceptual change. From that moment on, material tradition is not just the function of a linear time base any more (the speed of history), but a new, basically atemporal dimension opens, short-cutting the emphatic time arrow and demanding for a partial differentiation as familiar from the infinitesimal calculus once introduced by Leibniz as a measure of change *within* speed.]

Not yet memory? Focus on micro-storage tempor(e)alities

[Media archaeology as method couples evidence of time-critical human perception *tightly* with technological knowledge. "Data Retention" in fact is most precisely known from static data storage within the computer.

357 Viola 1990: 47

358 See http://www.iasa-web.org/IASA_TC03/IASA_TC03.pdf, accessed June 2011

To ensure that the data in the elementary cell will not be altered, the SRAM (static Random Access Memory) must be supplied by a power supply that will not fluctuate beyond plus or minus five or ten percent. If the elementary cell is not disturbed, a lower voltage is acceptable to ensure that the cell will correctly keep the data. "In that case, the SRAM is set to a retention mode when the power supply is lowered, and the part is not longer accessible."^{359]}

Micro-archiving the present: intermediary storage, digital delay

Already electro-mechanic transmission of photographic images *via* telegraph cables in 19th century was performed by intermediary storage, the *quasi*-"digital" data carrier of punched cards and relay amplifiers of the electric signals. This relieved communication engineering from the delicate time-critical synchronisation problem between sender and receiver.³⁶⁰

This is known in digital image transfer as well: In the convergence between a repetition and a renewal "lies the tendency to archive while bringing forward"; past and present become instantly simultaneous. "While it loops the past, the digital creates [...] an archival strategy where time passed becomes constantly accessible for the future. Reality's duration seems to have become an archival stream of information potentially open for access at any other time."³⁶¹

The micro-temporal *camouflage*: High Frequency Trading

"Real time" does not come naturally, but is a technological artefact. There is a fuzzy present in the Internet. In Internet packet switching, ultrashort-time memory is integral in the technical part of the transmission itself where the traditional contradiction between storage and transmission collapses. With the "hyperbolic temporalities of digitality"³⁶², network culture is less about clock time but more about delays, latencies.

359 The Chip Collection, <http://smithonianchips.si-edu> (Document of the Integrated Circuit Engineering Corporation), accessed May 2014

360 See Christian Kassung / Franz Pichler, Die Übertragung von Bildern in die Ferne, in: Albert Kümmel-Schnur / Christian Kassung (ed.), *Bildtelegraphie. Eine Mediengeschichte in Patenten (1840-1930)*, Bielefeld (transcript) 2012, 101-121 (110)

361 Markos Hadjioannou, *From Light to Byte. Toward an Ethics of Digital Cinema*, Minneapolis (Univ. of Minnesota Pr.) 2012, 174

362 An argument by Jussi Parikka, *Of Queues and Traffic: Network Microtemporalities*, lecture at symposium *Digital / social media and memory*, University of Glasgow, April 17th, 2013

At the virtual Stock Exchange, time-critical temporalities become economical temporalities. High Frequency Trading operates with time-"hiding" purposes like these, just like perceptual experiments in the 1960s: smuggling ultra-short moments of Coca Cola advertising into a regular TV movie which was not consciously noticed by the viewer.

In High Frequency Trading the beast are time-beasts. micro-temporal worm holes. The focus shifts from macro-temporal economical cycles subsumed as "history" to micro-temporal intervals which undo the emphatic difference between the processual present and the archived past. Time-critical media analysis in that sense helps to develop to create a new, different, non-historicist language of timings.

For the traditional time-based art forms like literature and theatre, such an analytic language has been developed, encompassing terms like endurance, frequency, recurrence, narrative speed, time-critical occurrence, anachronies.³⁶³ It is time to extend this language to the process which happen within the machines.

The aesthetics of "instant replay"

- Micro-archiving of presence is conceptually and technologically implied in the real-time processing of signals, since as a digital time-discrete sampling and quantizing of moments from the present signal (punctualizing / mathematization the continuous signal event) it requires intermediary short-time storage of data. The concept of real-time and "interrupt" for user input in computing dislocates the metaphysics of pure presence to micro-deferred presence.

In techno-mathematical media which not only allow for re-play of recorded sound but as well interaction and applying intelligent search and sorting on the basis of algorithms, a whole scale of micro-temporal "archiving presence" takes place, starting from ultra-short intermediary storage of electronic equivalents to zero and one in registers and flags, up to time axis manipulations after the digital sampling or recorded audio signals.

The instant archivization of the present becomes apparent with newsradio channels such as German "Inforadio" at radio Berlin-Brandenburg rbb) as frequent errors in (re-)play. What appears like actual news broadcast, by mistake (the new editor pushes the wrong button on his digital control panel) a news just spoken is repeated again. All of the sudden (shock for the "presence" instinct authenticity contract between listener and radio station) it becomes apparent that there is not live transmission any more (Rumanean "trasmissione directa"), but digitally

363 See Gérard Genette, *Die Erzählung*, Munich 1994

stored ("sampled") sound files - a presence which is "archived" already. The present event and storage merge into one with the increasing digital, i. e.: archiving recording of present spaces. The presence of space itself is being transformed into time-coded snapshots like instant photography by I-pads which step by step ("one bit at a time") *samples* presence.

Different to the archive which is symbolical order, recorded by symbols (alphabet), thus: spatial orders, audio-visual media record signals which are physically functions of time. When these are being re-played, our senses are affected, in a non-historical way. There is no memory here, presence happens, like any electronic re-play is dynamic. Instead of psychoanalytic trauma-research, now an analysis of the techno-traumatic momentum is appropriate, about traumatic irritations of re-presencing induced by analog and digital technologies, such as: the phonographic voice of the dead and the real-time presence of archival records in Web 2.0 memories like the video portal YouTube.

"We would make a mistake if we think that [...] we could refer to a 'normal' sense of presence in the present: to an unmediated, integral presence. Nothing as such exists either. We are always anticipating and deferring, missing the presence." We all live with the media archive in both existential and technological ways. "Films, images and videos, here, are time capsules", but not of historical time "but the time of a deferred, diminished presence". A counter-archive would need to give back the presence taken away from present life moment by moment³⁶⁴ which actually happens on the technological micro-level as analog-to-digital-conversion ("sample-and-hold"). "Archives are always summoned to give back time. But what if they are asked to give back presence?" (Constant *ibid.*), just like Gordon Bell's *My Life Project* recording project, enabled by permanent data glasses.

The augmented present became practical in the relatively data-poor audio signal processing first: SONY publicised its IC Recorder ICD-SX733 (and other models) under the heading "Recording a few seconds in advance - the pre-recording function".³⁶⁵ Technical Manuals as ultimate media-archaeological "sources": "The pre-recording function allows you to record sound sources for approximately 5 seconds prior to the point when you press REC/PAUSE. This is useful for recording during interview of when making an open-air recording so that you will not miss an opportunity to start recording" - the extended "window of present" as known from Husserl's *Phänomenologie des inneren Zeitbewußtseins.*, in technical acts of re- and protention. The "half-second"³⁶⁶ which human

364 Constant, Erkki Kurenniemi (In 2048) (preliminary work towards) an online archive; <http://kurenniemi.activearchives.org>

365 http://www.sony-asia.com/microsite/recorders_imanuals/ICD-SX1000/gb/contents/TP0000019455.html

366 See Hertha Sturm, *Wahrnehmung und Fernsehen: Die fehlende Halbsekunde. Plädoyer für eine zuschauerfreundliche Mediendramaturgie*, in:

perception needs to process the present is beaten. The secret of this irritation of the present is a dynamic storage function: "Sounds for 5 seconds are buffered in the memory."

[A self-indexical malfunction (noise) suddenly pops up: "If you start recording with pre-recording function using the built-in microphones, a click noise may be recorded when you press REC/PAUSE"; therefore the use of an external microphone is proposed.]

The condition of possibility of "irritating the present" is here, once more, micro-storage. The system offers additional 24 photos in addition to the one actually shot - which is, maybe not by coincidence, just a "cinematographic" second of 24 frames.

This is the moment to recall Gotthold Ephraim Lessing's *Laokoon* theorem from 1766. His notion of "the pregnant moment" is exactly *not* identical with instant photography. Plastic and visual arts, he argues, should rather accentuate the re- and protentive moment, as exemplified in the ancient sculpture of the Trojan priest which only hints to his immediate death narratively described in Homer's *Iliad*.

Nowadays, in the age of almost unlimited storage capacities for digital data, the pre-recording mode is replaced by continuous recording - the real-time archive. Pro-active archiving here displaces the traditional repository for records emanating from the past.

"Temporary Storage"

Between the archive and the anarchive there is temporary storage. While archives essentially aim towards long-term, if not even the unlimited preservation of their documents and today's media archivists grapple desperately with the problems associated with "long-term archiving", the temporalisation of archives is an anarchival element in the economy of cultural tradition. Archives in motion and "temporary archives" are symptoms of this temporalisation of the archive. The immediateness of the retrieval of immense volumes of data through online databases contends with an increasingly short-term maximum usability period, which contemporary culture knowingly accepts. Yet this temporalisation of the symbolic order is predetermined at the operative level of the present itself, namely in the practice of signal and data transmission. Delay lines served the micro-synchronisation of PAL colour television signals as well as the short time maintenance of data words in the first electronic computers. It belongs to the nature of the so-called new media that they compute and switch, constantly accumulating interim values and then deleting them again. The mathematisation of technical

communication by Shannon focuses on coding and the transmission channel which requires discrete temporary micro-storage - an unexpected return of the familiar archival order yet critically radicalised. The stuffy vocabulary of classic archivology shatters on such temporal modes of technological action.

"Time of non-reality": *Totzeit*, negative time

Not only do electronic systems replace perceptible timing operations by subliminal micro-temporal operations (like the clocking and cycling units in digital computing); a new temporal quality emerges with "binary" information theory: Norbert Wiener's notion of "time of non-reality", in fact negative time which does not numerically "count" in binary computing - the real switching moments.

The temporal wall arising: Moore's Law

In ancient Greek, *tó katéchon* signifies "that which withholds". The term appears in an eschatological context in apostle Paulus' 2nd letter to the Thessalonians in the New Testament, addressing a situation inbetween storage and delay. For Christian theology, *katechon* is the term for delaying the return of the Anti-Christ, that is: the end of the world (later to justify the political order of the Roman empire and other institutions).

The *kaTEChon* becomes a real techno-political iusse in computing regarding the dynamics of so-called Moore's Law, proposed in 1965 by co-founder of Intel Gordon Moore, stating that the number of transistors in an integrated circuit doubles approximately every two years.³⁶⁷ But this law has its in-built structural limitation and temporal end: "[T]he law will run out of steam, i. e. the improvements of conventional ways of manufacturing microprocessors, graphics chips and other silicon components will hit a wall: drastically new ideas will be required."³⁶⁸ Nanotechnologies or even *unconventional computing*³⁶⁹ is the answer to beholding the end of "Moore's Law".

Integrated circuits can be reproduced "with the ease of taking a picture, using optical masks in multiple exposures through the process of photolithography. The self-fulfilling prophecy of the semiconductor

367 Gordon E. Moore, Cramming more components onto integrated circuits, in: Electronics, Bd. 38, Nr. 8 (1965), 114-117

368 Chapter 2 "Moore's law and turing's Barrier", in: Christian S. Calude (2017): Unconventional Computing: A Brief Subjective History, in: Andrew Adamatzky (ed.), Advances in Unconventional Computing, vol. 1: Theory, London et al. (Springer), 855-864

369 As described, e. g., in Andrew Adamatzky (ed.), Collision-Based Computing, London et al. (Springer) 2002

industry, called Moore's Law, has turned into a stable temporality itself, serving as the primary basis for predicting future technological progress."³⁷⁰ When such computational components become integrated in larger networks, this results in a new kind of infrastructure which is rather time- than space-oriented. With algorithms operatively embedded into ever smaller integrated circuitry, the new micro-city is populated by nonhuman actors. Techno-mathematical intelligence has finally replaced the concrete wall.

SIGNALS IN ACTION. An Archaeology of Time-Critical Infrastructures within Media Technologies

Time-critical media

Philosopher Ernst Cassirer once pointed out that a technical being can only be captured during its actual operations.³⁷¹ This distinct quality counts all the more for the technological escalation into electronic media. They are in their medium-being only when signal processing, electrically biased, "under voltage". This makes them especially sensitive to micro-temporal intrusion, irritation and manipulation - much more than previous cultural techniques like alphabetic writing which became time-critical only when coded into electric telegraphy.³⁷²

"Bias" originally is a technical term in electronic engineering describing the necessary current to operate a vacuum tube (esp. triode) - a literally pre-conditioning, a ground tension for making the circuitry work at all, an electric (thus truly media-archaeological) *a priori*.

In electronic television, the exact synchronisation, thus timing, of signals becomes crucial for its success in the human *aisthesis* of image perception indeed. With techno-mathematical computing where minimal temporal moments become critical for the success of the whole process of internal calculation and human-machine communication ("interrupt"), time-criticality becomes a new epistemological object in the economy of knowledge. Since in media culture events are rather computationally counted than textually narrated, time-criticality needs to be focussed by process-oriented (thus dynamic) media archaeology.

370 Volmar / Stine, draft edited book project *Hardwired Temporalities. Media, Infrastructures, and the Patterning of Time*

371 "Das 'Sein' der Technik läßt sich selbst nicht anders als in der Tätigkeit erfassen und darstellen." Ernst Cassirer, Form und Technik, in: idem, Symbol, Technik, Sprache. Aufsätze aus den Jahren 1927-1933, ed. Ernst Wolfgang Orth / John Michael Krois, 2nd ed. Hamburg (Felix Meiner) 1995, 39-91 (48)

372 Florian Sprenger, Medien des Immediaten. Elektrizität. Telegraphie. McLuhan, Berlin (Kulturverlag Kadmos) 2012

Time-critical signal archaeology is not simply concerned with so-called "time-based arts" (which start with oral prosody and theatre already, leading to film and other mass media dramaturgies) but with *kairotic* media technologies. Time-criticality in its media-technological context does not refer to a philosophical or critique of contemporary politics or ethics but rather to a special class of events where exact timing and the temporal *momentum* is literally "decisive" for the processes to take place and succeed at all.

Video artists like Nam June Paik and Bill Viola have articulated electronic media temporality, transcending simply time-based performances (like theatre) towards an archaeology of such time-critical processes. In its ancient Greek sense, *crisis* refers to the chances of decision, with its temporal form being an impulse rather than a duration or narrative - *kairotic* time. Kairos - the ancient Greek god of the decisive moment - becomes proverbial in post-modern just-in-time production in both industry and technologies, as well as in deadly situations like anti-aircraft prediction in Second World War.³⁷³

In its etymological roots, "time" itself refers to divisions of continuity, to the cutting edge. Apart from its long aesthetic tradition, the cultural impact of time-criticality escalates with (and within) technological media, starting from photographic exposure time which almost shrank towards zero. Signals which are operated with electronic speed can hardly be followed by human consciousness like, for example, symbols (printed letters) in textual reading. When signal transfer happens below human sensation, it can be spotted only by time-critical observation. For subliminal events the true archaeologist of time-critical knowledge are technical media themselves; only with the emergence of highly sensitive measuring instruments since the 19th century time-critical processes like the runtime of signals within human nerves became analyzable at all.

The analysis of time-critical signal processing both in animals and in machines reactivates previous cybernetic assumptions under the specific perspective of micro-tempor(e)alities. The acknowledgement of the unity of perception-in-action implies the notion of time-critical signal processing, encompassing both electronic and technomathematical systems. Time-critical signal processing as a topic of applied mathematics - in the neo-cybernetic sense - does not refer to electrical engineering only, but to organic bodies as well.³⁷⁴ Signals of interest range from sound, images, and sensor data to telecommunication (such as radio signals). Technical media, in this context, act as agents of signal

373 Siegfried Zielinski, *Archäologie der Medien. Zur Tiefenzeit des technischen Hörens und Sehens*, Reinbek (Rowohlt) 2002, 43

374 See J. D. North, *Application of Communication Theory to the Human Operator*, in: Colin Cherry (ed.), *Information Theory. Papers read at a Symposium on 'Information Theory' held at the Royal Institution, London, September 12th to 16th 1955*, London (Butterworths Scientific Publications) 1956, 372-389

analysis: biological data (from the human body) are retrieved (and transformed) by time-varying measure media such as sonography, electrocardiograms.

Techno-logical clocking *versus* religious timing

Coupled to ubiquitous time-keeping technologies, man becomes a servomechanism of his clock. McLuhan concludes: "This continuous modification of man by his own technology stimulates him to find continuous means of modifying it", resulting in time-critical symbiosis.³⁷⁵ Such an analysis brings together disciplines which are usually separated in the academic faculties: humanities, engineering, cultural studies, mathematics, neuro-sciences, media studies.

The relation between operative technologies and performative culture, considered on the media-archaeological level, concerns nondiscursive regimes with an inherent chrono-logics of its own. Are humanly triggered technologies - once they have become operative - indifferent to the question whether they have been installed out of a discursive bias or not, even if they bear the imprint of this bias in technical form? Is there any close association between cultural techniques like liturgy, e. g., and the algorithm as mathematical procedure? What differentiates general cultural technologies from genuine media technologies, and is there a non-cultural, auto-poietical element at work in technical media? Discursive metaphors both create and obscure media practice. An analysis of the techno-procedural *arché* (rather than simply historical "origin") of the oscillating mechanical clock from late medieval monasteries focuses on the epistemological dis/continuity from religious timing to genuinely time-based media processes, resulting in an awareness of differential oscillations (Huygens, Mersenne, Maxwell, Hertz et al.) which both separates and re-aligns the Pythagorean cosmology from the electro-technical and techno-mathematical media age. If time-measuring media is more than simply an assembly of technologies (tools, material artefacts) but depends upon the existence of a wide range of sensorial techniques which drive and modulate their specific development, the religious system of co-ordinated action comes under consideration. The relationship of religion and technology is a provocative one; they do not take on a common ground but belong to different realms of practice and experience. For Ernst Cassirer, in a somewhat paradoxical definition, "symbolic forms" such as myth and art (among others) are "the specific media created by mankind in order to dissociate itself from the world and thus be re-united with the world the more firmly"³⁷⁶ - *religio* as a special kind of symbolic action.

375 See J. C. R. Licklider, Man-machine symbiosis, in: xxx, 1960

376 "[...] die eigentümlichen Medien, die der Mensch sich erschafft, um sich Kraft ihrer von der Welt zu trennen und sich eben in dieser Trennung umso

A case of a religious encounter with a technology is the numerical measurement of time. With the invention of the escapement-driven mechanical clock within the context of Benedictine monasteries which are based on strict temporal discipline, the sensation of micro-periodical oscillations entered the occidental chronosphere. Remarkably, the origin of the oscillating clock stems from the climax of liturgic practice. From such techno-logical coincidences, media archaeology rather seeks to develop alternative frameworks for understanding shifting relationships between humans and machines in diverse and even distinct cultural traditions. The oscillating clock started as a technique in religious timing, but auto-logically generated a non-human mechanism, setting an artificial time-base. While apparently grounding in religious belief of world-order, the resulting techno-mathematical work auto-poietically started to develop into a world of its own.

On the one hand, only in combination with a Christian sense of temporal linearity and stimulated by a religious idea of infinity (since Augustinus) the question of time became open to be implemented in *operative* timing media. This mechanism, once it has been at work, rather unconsciously and paradoxically emancipated occidental culture from its dependency of cosmic-religious time.

The paradox might be formulated like this: In terms of cultural performance, the rhythmic sense of periodic beats is closely linked to monastic prayer and working practice, but triggered a rather nonreligious take-off in the awareness of operative oscillating mechanisms (the vibrating string, developing modern acoustics and other wave analysis to be synthesised in electronic media and the timing mechanism of computing itself.

In early 19th century, oscillation became even an epistemological term.³⁷⁷ As Hans Christian Ørsted remarked, if a human imagines a monochord string making its slowest vibrations, he might still be able to distinguish each vibration with our own eyes. But let the speed increase, "now we can no longer distinguish one vibration from the other; we see only the entire space through which the string vibrates filled by it. There is a gap between the point where the visibility of the individual vibrations ceases to the point where the deepest tone begins. Now imagine the vibrations proceeding with increasing speed and producing higher and higher tones"; in the end the speed of the vibrations becomes too great even to be perceived by the ear.³⁷⁸

fester mit ihr zu verbinden": Ernst Cassirer, *Zur Logik der Kulturwissenschaft*, Göteborg 1942, 25

377 See Bernhard Siegert, *Passage des Digitalen. Zeichenpraktiken der neuzeitlichen Wissenschaften 1500-1900*, Berlin (Brinkmann & Bose) 2003

378 Hans Christian Ørsted, *Experiments on Acoustic Figures* [1808], in: *Selected Scientific Writings of H. C. Ørsted*, trans. and ed. by Karen Jelved,

A most efficient device for intermediary storage of data in electronic high speed computing, the mercury-based acoustic delay line as Random Access Memory, required clocking for a sufficient synchronisation with the processing unit. "We might say that the clock enables us to introduce a discreteness into time, so that time for some purposes can be regarded as a succession of instants instead of a continuous flow. A digital machine must essentially deal with discrete objects."³⁷⁹

New kinds of bio(algo)rhythmization

The sense of measurable prosodic "beats" (*chronoi*, in Aristoxenos' term) is related to the engineering of poetic timing and the the discretisation of poetic speech articulations into distinct letters by notation (vowels and consonants), inducing its automatization and technological implementation.

The memory technique in oral poetry performances relies on sensorimotoric synchronisation and feedback, sometimes significantly coupled with a string instrument. "La diffusion nerveuse est comparable à la propagation du courant électrique à travers un réseau de fils conducteurs."³⁸⁰ Embodiment as form of *kinesthetics* epistemologically activates the assumption that both machines (technical or mathematical) and animals are governed by analogous feedback-processes.

The bio-rhythmical human experience of time (so-called "circadian time") as alternation of activity and rest over the course of day and night is of almost musical nature - rhythmic. As remarked by McLuhan in his *Understanding Media* (1964), the electric light has already profoundly irritated this rhythm by extending the day-time by an artificial medium ("electric light"). Television consumption (which had been the occasion for McLuhan's study) increasingly structured human attention different from the traditional circadian time rhythm. In times of pervasive *online* computing, this rhythm becomes coupled with the algorithms of computing itself. Increasingly, the rhythms of human activity are shaped less by natural environmental cycles like the presence or absence of daylight, but "more by rhythms in the data streams that occupy an ever

Andrew D. Jackson, and Ole Knudsen, Princeton (Princeton Univ. Press) 1998, 280

379 Alan Turing, Lecture to the Mathematical Society on 20 February 1947, in: The Charles Babbage Institute Reprint Series for the History of Computing, Bd. 10, A. M. Turing's ACE Report of 1946 and Other Papers, Cambridge, Mass. 1986, 111

380 Marcel Jousse, Le Style oral rythmique et mnémotechnique chez les Verbo-moteurs, in: Archives de Philosophie vol. II, Cahier IV: Études de Psychologie Linguistique, Paris 1925, 17

greater share of our attention"³⁸¹. So the "algorhythmic"³⁸² is no longer simply *within* the computing machinery, but it affects human temporal experience as such in a hybrid way - whenever human time and machine time are being directly coupled.

Culturally, a familiar way of information processing is the human-machine communication and its time-critical escalations in computer games. Such action / reaction loops were first tested in the psychophysiological laboratory of Wilhelm Wundt at Leipzig University around 1900 with its central artefact being a telegraphic device coupled to a chronograph in order to measure the minimal delay time (*delta t*) between incoming signal and human nervous reaction.³⁸³ Computer games are time-critical, with micro-temporal moves and short-time neurological memory. The message of the medium computer games is not stories, but instant feed-back. Man experiences himself in time-critical cybernetics when interacting with digital media. Micro-temporal events which govern human action can only be analyzed by non-human instruments; they become crucial in neuro-biology: "Many phenomena recorded from brain structures such as the EEG (electro-encephalogram) [...] are expressible as characteristic temporal activity patterns; their forms, however, mainly come from the recording method."³⁸⁴

The temporal momentum in technical (micro-)infrastructures

The temporal constellation which has replaced the narrative time series unfolding between beginning and end, in human-computer interaction, is the mode of *interrupt*. Hereby, *kairotic* time replaces *chronos*. Such interactive events between computer and human unfold rather algorhythmically than rhythmically as familiar from traditional culture, coupled to the steps which unfold within the computer itself, where instruction-execution tables express an ordering of inner events.

A time-critically sharpened reading of McLuhan's "medium is the message theorem" leads to a focused inquiry of the temporal momentum in technologies. This does not only concern the macrotemporal *bias of communication* in the sense of Harold Innis' media theory of cultural and economic power infrastructures, but the intensive microtemporality that pervades signal transduction in electronic circuitry and data processing

381 A core thesis of Josh Berson, as expressed in his lecture on "Circadian Selves", February 11th, 2013, at IxDA Munich. See <http://www.ixdamunich.de/2012/12/18/february-11th-circadian-selves-a-presentation-by-josh-beron>, accessed February 20th, 2013

382 Shintaro Miyazaki, *Algorhythmisiert. Eine Medienarchäologie digitaler Signale und (un)erhörter Zeiteffekte*, Berlin (Kulturverlag Kadmos) 2013

383 See Claus Pias, *Computer-Spiel-Welten*, Munich (sequenzia) 2002

384 Teuvo Kohonen, *Self-Organization and Associative Memory*, Berlin / Heidelberg / New York / Tokyo 1984, 90 f.

in Integrated Circuits - the drama of literally hard-wired temporalities within microchips which, as "embedded" or "ubiquitous" computing, are the elements of a topological (more precisely than traditionally "infrastructural") web of computational forces:

In a very different way, the temporal message of digital communication media is in temporal deferral: from *live on tape* to media content *on demand*. This is the temporal signature of webcasting different from broadcasting media like radio and television.³⁸⁵ This time-critical sovereignty and immediacy in access leads to a "tactilization", in fact: an almost *haptic* access to media time (to use one of McLuhan's terms for describing electroic communication). The clear distinction between what is present and what is past, what is transmitted "live" and what comes out of the archive, disappears. Some online-services of radio or TV channels offer access to commentaries on current news, while at the same time offering access to other commentaries on previous occasions. The delineations of the archive to the present become diffuse, almost fuzzy.

Technical *Eigenzeit* (the temporal logic inherent to media) shapes the collective perception of time; time itself loses its individual character. The study of time critically challenges media studies.³⁸⁶ What, in this sense, is the message of Internet-based communication? The dominant communication platform of today, the World Wide Web, needs to be analysed on its operative level of temporal processualities and eventualities.

From time-based narrative to time-critical action

Whereas narrative once has been the dominant art of time, symbolically dramatised time orders are now being reorganized by technologies.³⁸⁷ Real time analysis belongs to computing and signal processing and is not narratable any more, subject(ed) to the instant. Henri Bergson insisted on human perception of durable time (conscience) as against chronophotographical registering of temporal processes.

Story-telling is not an anthropological *a priori*. The traditional diegetic adaption of time-processing in the form of story-telling has become an

385 See Andreas Bade, *Das Internet als programmbegleitendes Medium des Hörfunks. Historische Entwicklung von Internet, Radio und ihrer Medientheorien*, Hamburg (Diplomica Verlag) 2009, esp. 57-86, *online* <http://www.mediaculture-online.de>

386 "Zeit ist damit auch die Herausforderung einer Medienwissenschaft": Stefan Rieger, *Kybernetische Anthropologie. Eine Geschichte der Virtualität*, Frankfurt/M. (Suhrkamp) 2003, 143

387 Paul Virilio, *Technik und Fragmentierung*, in: Karlheinz Barck u. a. (ed.), *Aisthesis. Wahrnehmung heute*, Leipzig (Reclam) 1990, 71-82 (71)

anachronism itself with time-critical electronic and digital media; since the phonograph and cinematography, the essence of technical media is time-axis manipulation. In digital topographies, emphatic notions of time turn into a function of arithmetical micro-timing, since algorithmic media operate radically time-critical; time here becomes the decisive factor. In this radically temporalised culture, speed becomes crucial not only in computer games but as well in virtual war and economy ("high frequency trading"). When communication goes online, the culturally familiar mode of story-telling is replaced by variable configurations of time and non-predictable actuality - enumeration instead of stories. Taken to its extreme, this hypertemporality becomes somewhat arbitrary.

Archival storage becoming time-critical technical memory

Traditionally being part of symbolic suspension from time (called memory) and itself being an agency of storage, even the archive and archival usage become time-critical. From a media-archeological point of view, the traditional archive gets deconstructed by the implications of digital techniques. Since antiquity and the Renaissance, mnemotechnical storage has linked memory to space. But nowadays the static residential archive as permanent storage is being replaced by dynamic temporal storage, the time-based archive as a topological place of permanent data transfer. The archive transforms from storage-space to storage-time. Classical archival memory has never been interactive, whereas documents in networked space become time-critical to user feed-back.

In electronic media, the classical practice of quasi-eternal storage is being replaced by dynamical movements "on the fly" as a new quality. Memory is technically defined as "a device into which information can be introduced and then extracted at a considerably later time"³⁸⁸ - close to what is known as a buffer in electronics. Minimal delay memories are at work in time-based and time-critical media even the more if we do not notice them. Drastically, these binary micro-memories dissimulate apparent "live" transmission by calculation in *real time*. In the development of one of the first full-electronic digital computers, the *Whirlwind* project for the US Air Force under the direction of Forrester soon after World War II, the solving of the data storage problem proved to be the crucial one, since high-speed data processing (necessary for real time interaction as intended with the *Whirlwind*) is often slowed down by the bottle-neck of intermediary data storage. The mercury delay line which was one of the alternatives proved to be too slow since it is based on electro-acoustic transduction. It finally took the electrostatic storage tubes (familiar with the TV tube) to address and store data with almost the proverbial speed of light itself. "The incorporation of the storage

388 Glossary, in: Edward B. Magrab / Donald S. Blomquist, *The Measurement of Time-Varying Phenomena*, New York et al. (Wiley) 1971, 314

element depended upon the progress of the storage-tube-research and development [...] especially after parallel transmission of digits had been decided upon [...]."³⁸⁹ Time-criticality here refers to both the external (techno-contextual) and the internal (techno-imminent) sphere.³⁹⁰ But writing this as a "history" itself dissimulates the time-criticality by submerging and suspending it within an overall narrative coherence. Time-criticality (which is about discontinuous moments) is better revealed by media-archaeographical analysis and diagrammatic representation. Software is a new kind of cultural artefact: not a material object any more, rather an executable file which unfolds only when being processed - a truly processual time-object. A computer as hardware can be traditionally displayed as an immobile object, but its „bit-critical“ processes are never in *stasis*, just like frequency-based acoustics (sonic evidence) needs performance in time to take place - different from visual images which persist in space. Contemporary time-criticism thus focuses on technomathematically implemented algorithms.

SYNCHRONIZATION BETWEEN HUMANS, BETWEEN HUMANS AND NON-HUMANS, AND BETWEEN NON-HUMANS AT ALL

Synchronicity as message of the measuring medium

In accordance with cognitive studies, the cold media-archaeological analysis of technological synchronization sharpens the awareness of analogies, as well as differences, to signal processing within humans as well. It is by autocorrelation that the human brain fuses sequential impulses with ultra-short distance into one "tonal" impression in its time-critical, that is: sonic (not acoustic) sense. The musical "consonance" theory can be media-experimentally enacted by EEG measuring; it is the "coincidence neuron" which compares the primary signal with the delayed one.³⁹¹ Here, synchronization (German *Gleichzeitigkeit*) actually happens within a fuzzy region of tolerance, since mental pattern recognition is dynamically co-emergent, not a function of a single hidden command organ like an oscillating clock.

This is the moment for Gottfried Leibniz' theory of pre-established

389 Kent C. Redmont / Thomas M. Smith, Project Whirlwind. The History of a Pioneer Computer, Bedford, Mass. (Digital Press) 1980, 180

390 On immanence in technical evolution, see Gilbert Simondon, *Du Mode d'Existence des Objets Techniques*, Paris (Aubier) 1958, chap. I "Genèse de l'objet technique: le processus de concrétisation", 19-49 (esp. on the thermionic tube); translation into English (Ninian Mellamphy): *On the Mode of Existence of Technical Objects*, London (University of Western Ontario) 1980, <http://accursedshare.blogspot.com/2007/11/gilbert-simondon-on-mode-of-existence.html>

391 See Martin Ebeling, *Verschmelzung und neuronale Autokorrelation als Grundlage einer Konsonanztheorie*, Frankfurt/M. et al. (Peter Lang) 2007, 52

harmony which explains how all worldly substances, though autonomous in themselves ("windowless", as defined in his *Monadology*, § 7), still "seem to causally interact with each other because they have been programmed by God in advance to 'harmonize'"³⁹². But different from Leibniz' philosophical approach, it is by measuring and modelling media only that this can be techno-mathematically imagined, like the van der Pol oscillator simulating the relaxation moment in neuronal cells with a gas-filled (neon) tube (Thyratron) and slowly charged capacitors which then abruptly discharge.³⁹³

Is there an incommensurability between phenomena of synchronization between humans, and technological synchronicity? Truly time-critical insight is a function of the measuring media itself³⁹⁴: a net of electrodes allows to register the activity of numerous neurons at the same time, resulting in the impression that neurons "fire" in coordinated pace, as "synchronous oscillation"³⁹⁵. Such neurological insight into the primordial synchronization of "firing" impulses itself is a function of high-sensitive measuring media; the detection of such a time-critical mechanism, at the limits of laboratory experimentation, requires algorithmic and information-processing mathematical modelling, which makes all the difference between emerging synchronization and synchronicity. The gap opens with "posthuman rhythmatcs" in contemporary popular music culture. Edgar Varèse, in 1936, predicted machines which could generate any arbitrary sound and beat or micro-durational pause - fractions of time in all ratios and exact repetition³⁹⁶, which is the essence of Lev Termen's *Rhythmicon* indeed.³⁹⁷

In terms of analysis, the human-machine-constallation is a synchronizing in a different sense, for example the laboratory measuring of human nerve reaction times by the microtime-critical Hipp chronometer in nineteenth century physiological laboratories. Once the human is coupled to the measuring instrument, he or she is synchronized with its inherent temporality; the temporal content of the resulting data looks human, but the message of such time-data is the chronopoetics of the

392 Wikipedia entry on "pre-established harmony", accessed September 27, 2017

393 See György Buzsáki, *Rhythms of the Brain*, New York (Oxford UP) 2006, 138 (fig. 139)

394 See Sebastian Klotz, *Das BOLD-Signal im MRT. Eine medienarchäologische Diagnose*, in: Moritz Hiller / Stefan Höltgen (eds.), *Archäographien. Aspekte einer Radikalen Medienarchäologie*, Berlin (Schwabe Verlag) 2019, 63-77

395 Barbara Hobom, *Auf der Suche nach der universellen Sprache des Gehirns*, in: *Frankfurter Allgemeine Zeitung* no. 284, 6 December, 2006, N2

396 "[...] das alles in vorgegebenen Zeiteinheiten, die ein Mensch nie einzuhalten vermöchte": Varèse, as quoted in: Kodwo Eshun, *Heller als die Sonne. Abenteuer in der Sonic Fiction*, Berlin (ID-Verlag) 2xxx, chap. 6 "Rhythmatische Frequenzen programmieren", 93-110 [EO xxx], 94

397 See Andrey Smirnov, xxx

machine itself.

Synchronization From a Media-Archaeological Perspective

Media archaeology, in its reactualization of cybernetic systems theory, analyzes signal transduction both in humans and in machines, while at the same time paying attention to discontinuities and asynchronicities inbetween them.

While performative "embodied cognition" differs from operative technical *implementation*, time-critical processes within human cognition, and within technological systems, can be correlated indeed.³⁹⁸ Human-machine interfaces increasingly interlace both signal events. Once humans are coupled to processual media, they are coupled to their tempor(e)alities; synchronisation is a forceful coupling in the time-domain.

The media-archaeological approach does not apply neurophenomenological analysis but an object- and process-oriented ontology of synchronization *from within* the technical apparatus. For technologies, there is no "time", since there is no phenomenological perception and "inner time" self-consciousness. Instead, we find a variety and "kosmos" of temporal operations which unfold, the *temporeal*.

Technological reification of time-keeping has resulted in the commodification of temporality itself.³⁹⁹ With cinematography as technical operation, in Bergson's criticism of what Heidegger later would call "vulgar time" in reference to the mechanical clock, only the representation of time has become reproducible, while disavowing any relation to temporality as such. In that sense, synchronisation is a coupling and has nothing "temporal" in itself which exists only in the the Kantean sense as mental condition (*a priori*) for the human possibility of perception.

Clock-based technical synchronization itself needs to be synchronized: "Through isochronic oscillation the pendulum can exist as the autonomous embodiment of natural or physical time"⁴⁰⁰, while the radio controlled clock needs to be periodically synchronized with a reference clock elsewhere. "The quartz oscillators used in digital electronics (which are used for synchronization rather than timekeeping) can drift [...]" (Reding / Palasti).

398 See Arkady Pikorsky et al., Synchronization. A universal concept in non-linear sciences, Cambridge (UP) 2003

399 See Mary Ann Doane, Has Time Become Space?, in: Liv Hausken (ed.), Thinking Media Aesthetics, xxx 2013, 99, referring to: Henri Bergson, Matter and Memory, New York (Zone) 1991: 143

400 Mackenzie 2001: 244

Media archaeology is less about the human use of technologies or instruments but about the co-agency of the machine. Some neurons in the human brain tend to "fire" in periodic frequencies and require synchronization in cognitive perception; that induces their modelling by technical oscillators. The moment humans are coupled to a machine / instrument, they become subject (like coupled clock oscillation: Huyghens) to their proper media time (*Eigenzeit*). This escalates with vibration / oscillating mechanisms which induce resonances within the human sense of time.

The human coupling to humans is performative; the machine coupling to machines is operative. A notorious enactment of the sublime borderlines between synchronicity and asynchronicity is the "phasing" technique applied by Steve Reich in his piece *Piano Phase* from 1967.⁴⁰¹ This chronopoetics results from magnetic tape recording and its options for subtle time axis manipulation, while failing when this composition is performed by human pianists. Syn- and Desynchronisation between even the most skilled musicians is always fuzzy, delayed synchronicity. Entrainment analysis between two players itself is a function of time-critical techno-mathematic motion tracking and capturing, with software platform tools like Eyeweb reiterating Marey's chronophotographic measuring of movement more than a century ago. The difference itself is a technological escalation: the option for realtime analysis enabling immediate feedback and modeling for performers as co-agency instead of belated reading of recordings. *Nota bene*, a synchronization algorithm measures data resulting from sensors, not movement as it occurs - the Bergsonian critique of cinematography.

[Media-archaeological artefact collections do not simply preserve machine elements but maintain them in a (re-)enactable state. Technical devices are in their media situation only when being in action, that is: when they are signal processing.]

In the media-archaeological perspective on synchronization, there is no *a priori* pre-cognitive notion of time, but rather an inductive departure of analysis from actual technologies; the despotic signifier "time" is replaced by a multitude of operative terms for signal events, such as "resonance" (from the mechanical tuning fork to the electronic resonant circuit); for digital systems. In computing, what is known as the motorical rhythm in humans, is replaced by the clocking of cycling units as precondition for storage-programmed algorithmythmics (Miyazaki).

Chrono-Technical Violence: Synchronization

401 David Linden, Das Spiel der "Brain Players. Rhythmen im Gehirn", in: Junge Akademie Magazin [Berlin] no. 4 (2006), 16 f. (17)

There is a privileged (all the more deceiving, though) affinity between the human auditory channel, and the frequencies of nerve cell signaling, to technological signal processing. That means, from the engineering perspective, for discussing electronically based communication processes, it makes sense "to use auditory terms [...] like *feedback* ... *reverberation* ... *tuning*"⁴⁰². "Sonicity" is a neo-logistic term for such an implicit message of "sound" as epistemological object which is primarily not its acoustic content but temporal signal form. From here results the analogy between sonic and media-technical articulations; their common denominator is arbitrarily structured, "dramatized" processuality.

This corresponds with the cybernetics assumption that synchronization in communication between machines (technical *and* mathematical) and animals can be (self-)controlled (Maxwell's "Governor") by time-critical negative feedback processes, as indicated by the subtitle of Norbert Wiener's 1948 publication *Cybernetics or Communication and Control in the Animal and the Machine*. The automatism of feedback differs from asynchronous "editing" of neuronal or technical memory such as film, sound, and video tape which "replaces the linear sequence of events *in time* with events juxtaposed in a time relationship established by the communicator" (ibid.).

Classical cybernetic systems theory fell victim to epistemically seductive analogies between timings in technical media and in the human brain, like "clocking"; neurophenomenology rather accentuates the difference between technical und cognitive "timing".

[In the neurophenomenological investigation of the aesthetic experience of music (Helmholtz 1863), temporal structures from neuroimaging data can be analysed most efficiently when using a neuro*dynamic* approach, whereas at present structure- and function-oriented neuroscientific approaches are dominant.⁴⁰³]

Simultaneity *unequals* synchronization.⁴⁰⁴ On the discursive level of symbolical time, the cultural concept of (global) history is a literary, narrative synchronization in the historiographical writing operation), an arbitrarily "agreed-upon chronology"⁴⁰⁵. Synchronicity, when applied to

402 Schwartz 1974: 23

403 Jin Hyun Kim, Shaping and Co-Shaping Forms of Vitality in Music: Beyond Cognitivist and Emotivist Approaches to Musical Expressiveness, in: Empirical Musicology Review, vol. 8, no. 3-4, 2013, 162-172 (168)

404 See Niklas Luhmann, Gleichzeitigkeit und Synchronisation, in: ders., Soziologische Aufklärung 5: Konstruktivistische Perspektiven, Opladen (Westdeutscher Verlag) 1990, 95-130

405 John Durham Peters, Nonsimultaneity, in: same author, The Marvellous Clouds. Towards a Philosophy of Elementary Media, Chicago / London (University of Chicago Press) 2015, 91

neural analysis itself, is a technological term, an artefact, since in the human brain or nerve oscillations, if at all, there is never exact clocking. Neuro-science and neuro-informatics separate.

Apart from the phenomenological analysis (Husserl / Bergson) of human cognition (and man-machine communication), there is the phenomenon of "emerging synchronization" *within* technological communication. In media theory, it is appropriate to call such processes "musical" in its archaic sense (ancient Greek *mousiké*), a symptom of which is the frequent use of implicitly "musical" terms for micro-temporal communication by engineers and mathematical theories of technical communication.

Audio-Visual A/Synchronicities

Phase-delayed signals, consisting of piezo-electric modules, served for the micro-synchronisation of PAL colour television RGB signals (von Bruch's "color clock"), just like the Acoustic Delay Line has been developed for the short-term maintenance of data words in the first electronic computers.⁴⁰⁶

This intra-technological delay differs from human sensory synchronization such as the audio-visual perceptual gap since the early times of sound film resulting from the different signal run times of acoustics and light. The media-archaeologically formative époque of television broadcast technology, before magnetic video recording, just knew "live" transmission; in the meantime, the Marconi Company (GB, 1957) developed the Marconi Telerecording, a recording from screen by film camera with fast intermittent mechanism, while sound was recorded on a synchronised tape recorder with perforated recording material (double tape). In the Dolby Digital cinema system, digital sound information is coded in the space *between* the celluloid film perforation - while the parallel optical analogue wave form is still continuous. Digital sound recording corresponds with the discreteness of cinematographic projection again which, according to McLuhan 1964, rather relates to the mechanical age than to electronics. But with the digitalization of the sound film, it becomes "silent" film again. A differential synchronicity arises (an oxymoron); in traditional sound film, the acoustic track is 21 frames *in advance* of the actual image, for compensating the gap between acoustic (delayed) and visual signal run time in the moment of cinema projection.⁴⁰⁷

406 See Alan Turing, The State of the Art [1947], in: idem, Intelligence Service, ed. Bernhard Dotzler / Frierich Kittler, Berlin (Brinkmann & Bose) 1987, 183-208 (esp. 186-192)

407 See Siegfried Kracauer, Theorie des Films, Frankfurt (Main) 1960, 158, on "Synchronismus - Asynchronismus"

In his physiological laboratory equipped with time-critical measuring media, Hermann von Helmholtz detected that the run-time (speed of propagation) of signals in the motoric nerves of a frog counts around 24 meter/sec. This speed reminds of a synchronization problem within humans, when technical audio-visual synchronicity leads to irritation when confronted with physical signal run times in real nature; a lightning stroke is seen more immediate than the accompanying thunder is heard. For the temporal domain of human perception, the media psychologist Herta Sturm once experimentally explored that while every day perception which always includes a slight temporal delay of reaction involving a kind of inner speech ("subvokales Ansprechen"⁴⁰⁸), electronic media force their audience into immediate affective response. Immediate media interfaces deprive humans of their natural chance of delayed perception. What occurs within this half-second? With electronic signal immediacy, humans are deprived of this chance of delay⁴⁰⁹. The almost missing micro-temporal gap, is comparable to the essential "time of non-reality" (Norbert Wiener) in digital switching between zero and one.⁴¹⁰ There is asynchronicity in signal processing regarding humans on the one hand and electronic machines on the other, a difference in phase delay of signal transfer between technology and human physiology.

[Quasi-technical timing can be detected within human neuroprocessing itself, a kind of chrono-engineering. Pre-emptive activity is what apparently is stimulated in the pre-frontal cortex of the brain which does not simply react to incoming sensations but time-critically tends to anticipation, which is familiar from the difference between "live" and "real-time" signal transmission within communication media). The a-subjective and the a-human within humans (Gilles Deleuze) is a chrono-technical one.]

Time-Critical Media Operations as Implicit Chrono-(Syn)Sonicity

Technical con-temporaneity differs from the human or social one. The synchronization in opto-electronic communication between the electronic Cathode Ray Tube camera and the corresponding receiver tube in television is time-critically delicate; otherwise there could be no mass media effect.

408 Hertha Sturm, Wahrnehmung und Fernsehen: Die fehlende Halbsekunde. Plädoyer für eine zuschauerfreundliche Mediendramaturgie, in: Media Perspektiven 1/84, 58-65 (61)

409 Herta Sturm, Fernsehdiktate. Die Veränderung von Gedanken und Gefühlen. Ergebnisse und Folgerungen für eine rezipientenorientierte Mediendramaturgie, Gütersloh (Bertelsmann-Stiftung) 1991, 55

410 See Claus Pias, Time of Non-Reality. Miszellen zum Thema Zeit und Auflösung, in: Axel Volmar (ed.), Zeitkritische Medien, Berlin (Kulturverlag Kadmos) 2009, 267-282

In cultural history, *posting* letters, phonographical recordings and cinematography has resulted in asynchronous communication, always in delay between sender and receiver, while simultaneous telephone and radio, in analogue days, have been - in implicit sonicity - "the mechanization of post-literate acoustic space"⁴¹¹. The specific "live" modality of broadcast media is synchronicity, ubiquity and differs from the temporal modes of digitally coded communication media which are based on intermediary storage on the micro-temporal level - therefore always delayed against the punctual "now".

Electro-technical synchronization in television image transmission and reception has been replaced by digital signal processing and transfer in realtime; the "live" transmission of images of the American bombing of Bagdad during the Iraq war in the 1990s by the TV channel CNN: "indissociable d'une nouvelle temporalité de la technique d'une autre rythme"⁴¹² which is, in fact, not musical but a function of algorithmic pixel calculation.

There is auto-synchronization in the circuitry of human / machine couplings, such as the Bosnia-Montenegrain *guslari* singers of epic verses are coupled to the one-string instrument (the *gusle*) not for the purpose of instrumental amusement of the audience but for servo-motoric feedback in creating the just-in-time prosodic rhythm of oral poetry. Software such as *The Amazing Slow Downer* allows for time-warping and -stretching of reference Jazz-musical recording without altering the pitch (beats per minute). This allows the students to re-inhabit the master solo, *to play in synchrony* with the (recorded) master, in the same frequency (be it in-phase or anti-phase synchrony). What has been the Harmonizer in Kittler's electronic times for time axis manipulation, nowadays is achieved by computational synchronicity; *predictive analytics* is algorithmically counter-calculating the present in real-time, like the Stealth Fighter computationally counter-corrects the physical distortion of the airplane shape which is necessary to deceive the enemy radar beams.

So-called *time-based media* in the traditional sense comprise literature and theatre, then gramophone, film and television. Media archaeology sharpens this notion by focussing on *time-critical* processes as well, where micro-temporal events are crucial for the overall process to happen at all: succeeding synchronization in telecommunication, and clocking within computer data circulation.

The term contemporaneity denotes rather the coming together of different times than simple being-in-the-same-time; technical

411 McLuhan, "Five Sovereign Fingers Taxed the Breath" (1954), xxx

412 Jacques Derrida / Bernard Stiegler, *Échographies de la télévision. Entretiens filmés*, Paris (Galilée / INA) 1996, 83

synchronisation is *forced contemporaneity*. In early image telegraphy, the speed of transmission itself had not been decisive, but rather the synchronization of sender and receiver⁴¹³, such as in time-critical electro-mechanical television signal generation and reception of *moving* images.

The time-criticality of synchronism is the moment when a technology is not simply an escalation (literally: further "step") of a cultural technique any more but becomes epistemogenic. In English, *isochronism* signifies "*equal in time, or performed in equal time*", while synchronism refers to "*occurring at the same time, or having the same period and phase*"; the difference is between ontological and operative times. In electro-mechanic archaic television, this resulted in the Automatic Tuning-Fork Synchronizer and the Toothed-Wheel or Phonic-Wheel Motor⁴¹⁴; *nota bene*, once more, the use of "sonic" terms in engineering.

There is a difference between physical "presence" experienced by players in computer games (such as in LAN-parties), virtual "presence" (which is realtime calculation for sensomotoric synchronism as condition of the immersion experience in the game) and psychological "presence" in computer games.⁴¹⁵ When humans are loosely coupled to a gaming device, they are just contemporary with the machine action.⁴¹⁶ But tightly coupled to a computing device in gaming especially, and in ubiquitous computing generally, they become synchronized, subject to techno-mathematical time. In reverse, the machine is programmed in order to adapt to the human asynchronous rhythms, by means of the "interrupt" option which momentarily suspends machine action, waiting for the human input like the radar monitor equipped with a light pen at the CRT of the Whirlwind computer.⁴¹⁷ But temporal complexity *within* computing results in functional asynchronicities, such as the different rhythms (clocking) of cycling units.

There is implicit "musicality" in electro-technical timing-as-synchronization; time-critical media operations unfold in implicit chronosonicity. The very term "synchonicity" (like Aristoxenos' *chronoi* as time units of poetic prosody) already admits that there is no single transcendent parameter "time". "There is not `the time´, but only clock

413 See Christian Kassung / Albert Kümmel, Synchronisationsprobleme, in: Albert Kümmel / Erhard Schüttpelz (Hg.), Signale der Störung, München (Fink) 2003, 143-165

414 Collins 1932 / 1991, chap. VII, 205

415 See J. Bryce / J. Rutter, In the Game - In the Flow: Presence in Public Computer Gaming. Poster presented at 'Computer Games & Digital Textualities', IT University of Copenhagen, March 2001; http://www.cric.ac.uk/cric/staff/Jason_Rutter/presence.htm

416 See Friedrich Kittler, entry "Flipper", in: same author, Baggersee, Munich (Fink) 20xx

417 See Pias 2002, xxx

readings"⁴¹⁸; instead of a despotic transcendent signifier called "time", *times* exist only as multitude. Once singular "time" is conceptually replaced by the description of discrete moments (Zenon "arrow flight" paradox, Aristotle's definition of *chrónos*), time measurements dissolve (in accordance with Bergson's criticism) to position measurements. When "time" implodes, instead we discover, from media-epistemological perspective, the richness of micro-tempor(e)al multiplicities which unfold within high-technological processes.

The very term "synchronization" points to the artefactual character of technical *timing* where "time" is not externally attributed to it as a referential quality, but generated from within a concrete technology's *eigentime*.

Apart from the apparent "content" (result) of any synchronized action, its McLuhanesque "message" is that there is no time at all, which is only semantically attributed to transcendent signification which exists in culture as symbolic order only. When time comes into existence only by measuring (Aristotle), it is enforcing the symbolical on the real. The difference between symbolical time-ordering (such as narrative) and physical time is essential; different from thermodynamic (Boltzmann), informational entropy (Shannon) needs no term like "time" at all.

Resonance and "Syntony"

[In his book on synchronicity, psychoanalyst Carl Gustav Jung⁴¹⁹ defines the acausal connection of two or more psychic and physical phenomena, resulting from the archetype as *arché*: a dynamic which - like Leibniz' clock-driven "prestabilizing harmony" - governs human existence.⁴²⁰]

A self-performative form of synchronization is resonance. Martin Heidegger's use of terms from the sonosphere does *not* refer to explicit acoustics (as physical sound event) or to music as conceptual art form in culture, but rather to the implicit, epistemological meaning of sound as vibrating space. In the end of the 1930s, Heidegger defined human existence in resonance with ontological being.⁴²¹ Heidegger "understood" (German *vernahm*) the *implicitly sonic* nature of such vibrations - not in

418 Jürgen Ehlers, Concepts of Time in Physical Theories. Insights obtained and open questions, lecture at conference *On time*, 22-24 May, 2003, Einstein Forum Potsdam

419 Carl Gustav Jung, *Synchronicity. An Acausal Connecting Principle*, Routledge and Kegan Paul 1972

420 See <https://en.wikipedia.org/wiki/Synchronicity>, accessed July 13, 2017

421 "Das Wesen des Menschen [...] schwingt in dem Bezug des Seyns zu ihm. Diese Schwingung meint die unentschiedene Fülle des Entscheidbaren durch das eigene Innestehen des Menschen im Da-sein." Martin Heidegger, GA vol. 70, xxx, 125

its acoustic sense, nor as an auditory listening experience. He had to make use of sonic vocabulary as a substitutional way of expressing the microtemporal structure of the "event" of being.⁴²²

"The resonance principle is not totally new or unique to electronic communication. It has always been an element in painting, music, sculpture, and, to a limited degree, even in print. However, resonance is not a more *operational* principle for creating communication because much of the material stored in the brains of an audience is also stored in the brain of a communicator - by virtue of our shared media environment."⁴²³

The decisive technical configuration in the emerging epistemology of "radio" communication has been Heinrich Hertz' spark oscillator in correspondence with a "resonator". David Lodge later sonically called this electro-magnetically induced synchronization of distant objects "syntony", which in radio engineering resulted in the technical term *resonant circuit*.⁴²⁴

Electrotechnical synchronization takes place on several levels. Simple electric tuning is achieved by the *Schwingkreis* (resonant circuit), but "sympathetic electric resonance" is an "effect obtained when the electric oscillations which surge in a circuit send out electric waves of a given length and these strike a second circuit that is tuned to exactly the same frequency as the first one, so that electric oscillations will be set up in it"⁴²⁵. Damped and sustained oscillations" can be detected: "the energy of the oscillations that are set up in the aerial wire at the transmitting station is converted into electric waves. When these strike the aerial wire of your receiver they are converted back again into electric oscillations. The receiver detects the *oscillations* that are set up in it, not the electric waves, though it is called an electric wave detector [...]."⁴²⁶

Radio "Time Signals"

In the difference between the "synchronous" and the "simultaneous", the latter corresponds with McLuhan's notion of "acoustic space". Radio and wireless telegraphy reshaped each other. In World War One, at the Russian front, men listened to the spark acoustics of telegraphy as "radio entertainment". All electro-physical signals are (already) time-functions.

422 Rainer Bayreuther, entry "Heidegger und die Musik", in: Heidegger-Handbuch, ed. Dieter Thomä], chapter 2.2 "Auf dem Weg zu einer Akustik des Seyns": 'Stimmung', 'Schwingung', und 'Harmonie' nach Sein und Zeit", 2013

423 Tony Schwartz, *The Resonant Chord*, xxx 1974, 25

424 See xxx Aitken, *Syntony and Spark*, 1976

425 A. Frederick Collins, *Experimental Television*, Boston (Lothrop, Lee & Shepard) 1932; Reprint Bradley, IL (Lindsay) 1991, 205

426 Collins 1932 / 1991: 216

In the media-archaeological "pre-history" (*epoché*) of radio before it became a broadcast medium, radio has been a technology of synchronization: with the radio time signal, the medium message is its content as well, when listened to as communication - before, as a program format radio, this "figure" was pushed back to the "ground" (McLuhan). In 1912, the International Time Conference in Paris inaugurated the network of signalling stations with the Eiffel tower as center. *Watchmakers* once listened to its radio time signals.⁴²⁷

There has been a re-entry of synchronization within time-keeping itself. With telegraphy in Switzerland, a message could be transmitted in "less than no time" - at least in terms of local sun-dial time. Since mid-19th century Bern local time became federal time in Switzerland: time sent as telegraphic signal ("Einheitszeit"), used in coupling with railway logistics. For other contexts, local time remained partly intact.

The Time-Critical Electronic Television Image

The earliest known recording from a television program - the revue *Looking In*, performed by the Paramount Astoria Girls on the BBC Baird television system (30 lines) in April 1933 - has been recorded by an enthusiastic amateur on his Baird Phonovision system equipment on aluminium disc. Recently processed and restored by digital filtering, the key to clarity is the neuronal perception of movement itself. Any reproduction of one of the 30-line television broadcast as photographic stills in a printing medium gives a wrong impression of what had been actually seen. Here the time-critical comes in, since printed records (be it texts, be it images) miss a crucial element: time.

"A single frame of the Paramount Astoria Girls may be crudely recognisable, but when seen as a moving dynamic television image, the girls come to life before our eyes. [...] it has much more to do with what we perceive than what is there in pixels, lines and frames. What we are experiencing is not the detail that the eye sees, but the recognition of movement that the brain sees."⁴²⁸

Digital Synchronicities

The modelling of human neuronal synchronization, since the cybernetic brain-computing metaphor by McCulloch / Pitts and von Neumann, is

⁴²⁷ See Horace Hurm's Ondophone (1914), referred to by Gabriele Balbi / Maria Rikitiaskaia in their lecture "The Age of Synchronization", at the conference *Zeitregime und Geschichtswissenschaften* of the Swiss online portal *infoclio.ch*, October 14, 2016, in Bern

⁴²⁸ Donald F. McLean, *Restoring Baird's Image*, London (The Institution of Electrical Engineers) 2000, 211 f.

grounded in the very materiality of digital computing. The fundamental unit of memory, the electro-magnetic relay, for electronic engineers, seemed "naturally adapted to the binary system" since they did not attempt to measure gradations of charge at a particular point but were "content to distinguish two states"⁴²⁹ - which makes all the difference to the time-functional classical black & white television scan line, and to analog computing. The flip-flop as truly binary device provides for the rhythm. Magnetic wires or tapes or acoustic delay line memories recognised "the presence or absence of a pulse or (if a carrier frequency was used) of a pulse train"⁴³⁰. All of the sudden, beyond the phenomenological notion of the continuous endurance of time (Bergson), computer time actually *sounds* different.

The core media-epistemogenic act in interfacing the physical world to numerical computing is analog-to-digital sampling. This signal processing basically consists of an *a priori* synchronisation. By high-frequency clocking (the 44.1 kHz standard for audio, such as for Compact Discs), the signal is first of all time-discretely sampled, before being evaluated ("quantised") in terms of information (measured in bit-depth).

In such concrete chronopoetical scenarios, media archaeology identifies the digital "shaping of time" (George Kubler). The sample-and-hold mechanism (before the signal actually gets digitally quantised) "stores" its records only for a fraction of a millisecond. Condensers figure among the smallest electro-physical storage elements, and combined with transistors they function as micro-memories here. The electronic sound slice is a temporal being in such electronic circuits, not punctual, but a suspended instant of time as voltage.

"Social" media synchronization

For radio amateurs, head-phone signal reception had been strictly individual, while synchronization of collective reception has a strict electronic condition: the vacuum tube (later transistor) for amplification of acoustic dynamics to operate loudspeakers.

In times of "social media", the traditional synchronisation of society by radio or TV broadcasting (the simultaneous reception in mass media culture) is replaced by *temporary* synchronisation of mobile communication devices ("Flash mobs").

429 Section 5.2., in: Arthur W. Burks / Herman H. Goldstine / John von Neumann, Preliminary Discussion of the Logical Design of an Electronic Computing Instrument, in: John von Neumann, Collected Works, vol. 5, ed. by A. H. Taub, Oxford (Pergamon Press) 1961, 34-79; reprint in: Swartzlander (ed.) 1976, 221-xxx (227)

430 Burks et al. 1961 / 1976: 227

The so-called Community Memory project in the San Francisco area has been an early attempt to place computer terminals in public places, to get access to documents centrally stored in a main frame computer (the SDS 940). This telephone-line, Modem- and computer-based social network emerged in the 1970s, as an early application of a Time-Sharing operating system. What has been "social interaction" among individuals in sociological terms becomes cold synchronization.⁴³¹ The media-archaeological condition for enabling such *online* social synchronization has been the magnetic core memory in the central main frame computer. This binary grid is no metaphor on neuronal data processing any more.

431 See Stefan Höltgen, "All Watched Over by Machines of Loving Grace". Öffentliche Erinnerungen, demokratische Informationen und restriktive Technologien am Beispiel der "Community Memory", in: Ramón Reichert (ed.), Big Data. Analysen zum digitalen Wandel von Wissen, Macht und Ökonomie, Bielefeld (transcript) 2014, 385-403 (386)