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TO DIGITAL FLESH:
UNDERSTANDING TECHNOLOGY
THROUGH FASHION**

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1. Introduction

Technology is developing fast. Artificial Intelligence is becoming more and more complex, which leads to chat-bots developing their own conversations and languages. In 2016 Google's AI AlphaGo Zero has even beaten Go-world champion Lee Se-dol. Nevertheless, we are still a long way from truly self-conscious intelligent machines. The contemporary discourse is held spellbound by the idea of a singularity and the dawn of the *posthuman*. Whether or not there will be a singularity, an ultimately superintelligent hybrid of human and artificial intelligence, as Ray Kurzweil imagines it remains questionable. The tendency toward a change in what we understand as human is definitely under way. The reason is first and foremost technology's tendency to get closer to the body and under the skin. Also it permeates all kinds of life-worlds and thus creates new affordances.

Technologies like personal computers and smartphones, that gather all the technological force and intelligence in one place, will change in the near future into distributed forms AI. Smaller devices, hidden in objects and bodies will form a distributed net of smart technologies, whose intelligence emerges from a multiplicity of interconnected devices. This is what Bruder¹ coins as *infrastructural intelligence*. This concept of artificial intelligence can be traced back to neuroscientific conceptions of how the brain works, namely as an interplay of distributed processes within the topology of the brain. It is a salient characteristic of emergent technologies to not gather all intelligence and functionality in one place or one device. What is envisaged with the *Internet of Things* (IoT) is an infrastructure of interconnected devices that create a smooth user experience. These technologies will be integrated in everyday objects and turn into a form of *ubiquitous computing*.

Information flow is realized by sensors and wireless connections. Thus the technology itself is barely visible, as shown in visualizations of future households. Recent science-

fiction movies that imagine a not too distant future such as *Her*² or *Advantageous*³ show barely any hardware anymore. Technology is imagined and already being built as distributed, connected and hidden infrastructure of the life-world. This tendency is most obvious in fashion: Wearables have become common already a few years ago. For example the brand Fitbit, the smart wristband that measures health related data, was founded already in 2017. Wearable technologies do not give away their technological character easily: Smart fabrics look like traditional fabrics, smart watches appear as dumb watches, smart bags resemble any other backpack. The device Ringly for example is a wireless smart object that looks like any standard form of jewelry: A ring with a gemstone that will give light signals matched with the arrival of preselected messages on the smartphone. Soon there will be *digital skins* that are tattooed to the biological skin and become part of the sensing system of our bodies.

My working hypothesis is that the fields of fashion and wearables are most advanced when it comes to developing devices that are integrated in everyday objects. They are pioneers with regard to *ubiquitous computing* and *infrastructural intelligence*. There is yet another point that turns fashion and more specific *digital skins* into an interesting field of research: The close proximity to the user's body. *Digital skin* tend to merge artificial and biological life. They allow artificial limbs to sense their surroundings and they might soon be able to enhance human senses through adding artificial sense organs to the biological setup. The intertwining of artificial and biological sensing alters deeply the social and material structures of our life-worlds. In this paper, I will propose a phenomenological concept to describe technological key features and understand their impact on human life. My aim is to generalize the idea of *digital skin* under the Merleau-Pontian term of the *flesh* and propose a hybrid concept of the *digital flesh* as paradigmatic for future technologies.

2. Digital Skins

What if you could choose a new face in the morning just as easily as you put on another outfit each day? Would you adjust your appearance according to your mood or to the challenges of the day? Technologies around *digital skin* could future humans allow to do that. *Digital skin is a concept*, which is currently inspiring a wide range of fashion-technology fusions. It covers both technologies becoming life-like and humans incorporating artificial devices, such as sensors from thin, stretchable materials attached to the skin.

The broad term of *digital skin* goes beyond what is covered by the label *wearables*. It brings us one step closer to the merger of body and technology: be it projections, smart fabrics or other flexible electronic surfaces that imitate the features of the human skin, like sen-

sitivity to touch, temperature and even self-healing. The field covered by this term includes fashion, science, medicine, design and artistic experiment, whereas these areas usually combine their efforts. My aim is to analyze this concept as a *posthuman* strategy of merging technology and biology in an image of generalized sensibility as Merleau-Ponty suggested it already 1964 with his notion of the *flesh*. *Digital skins* as they are used in conceptual fashion and smart wearables can be regarded as a paradigm to describe contemporary and future technologies, which form the *Internet of Things* (IoT). The IoT is structurally comparable to



Picture 14

This project has not yet reached the goal of digital skin, the devices have not merged completely with the fabric, they rather have become part of the design. In science Zhenan Bao's lab at Stanford University works on *digital skins* in order to equip artificial limbs with touch/temperature sensible surfaces. In this case, it is technology that becomes life-like. Stretchable sensor-materials are developed to equipped artificial prostheses or robot-limbs with sensation. The following considerations take the notion of *digital skin* in its different meanings as an inspiration to reflect on human cognition on its way to *posthuman* states - a journey that possibly started long before computers where on the horizon.

digital skins, because surfaces become sensitive, smart and highly connected, just as a skin is the medium to connect the nervous system with the outer world.

Digital skin starts, when the fabric or surface embodies smart technology: The fabric becomes the sensible or communicative. The ideal *digital skin* imitates and enhances the functionality of biological skin. It is vital to this concept that devices become nearly immaterial. The smart materials have to be expandable and washable just like natural skin or garments. This design idea challenges techno-science. New materials and implementations need to be developed, such as washable solar panels which are already being used in garments such as Pauline van Dongen's Solar Couture.

Both, lifelike technology and technologically enhanced human bodies demand that technology also becomes lifelike in its aesthetic qualities. In fashion one of the most obvious early examples of aesthetic usage of *digital skin* is Viktor&Rolf's show Bluescreen from 2002/03 (Picture 2), where clothes serve as bluescreen for image-projection.⁵

In this example, the moving body is turned into a screen and thus is rendered in part invisible or takes on an ephemeral quality. The dissolution of bodies into light, particles or morphable fluids is a topos in contemporary sci-fi movies too. Those images take the logic of *digital skin* a step further and dissolve bodies into the ephemeral aesthetics of

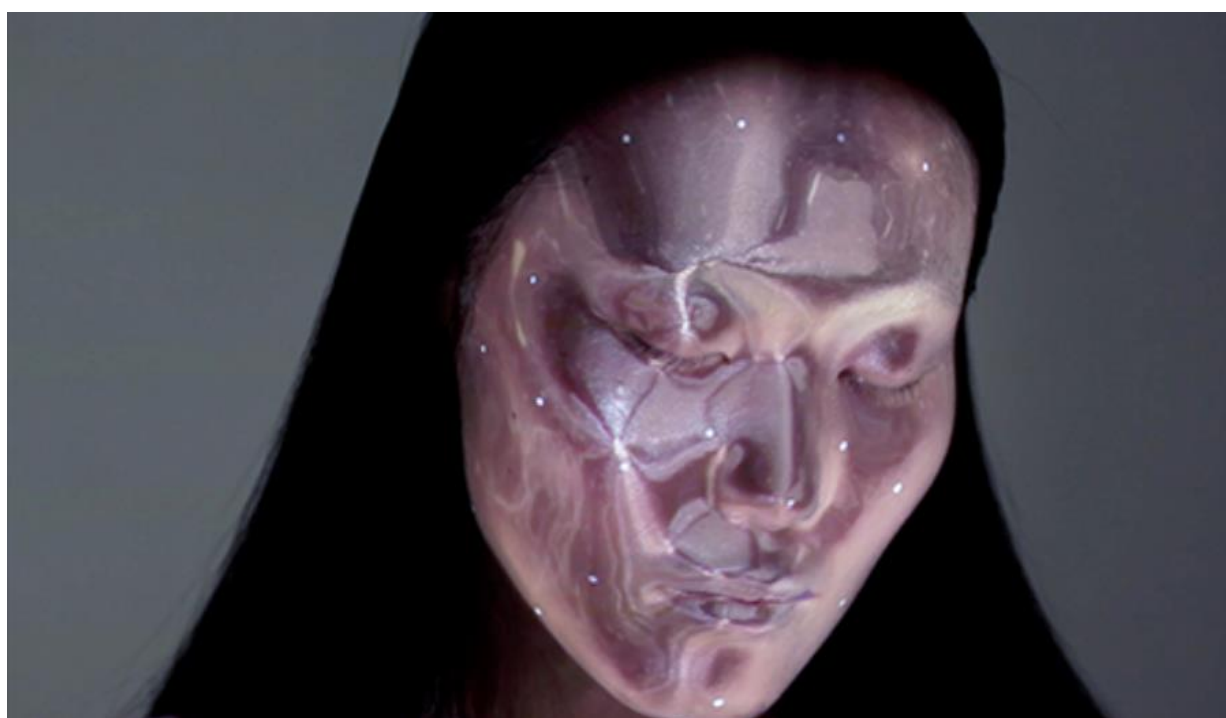


the virtual. One key scene is the very last scene of Wally Pfister's *Transcendence*,⁶ when the protagonists make their last appearance in the form of elementary particles. Another paradigmatic scene is to be found in Luc Besson's movie *LU-CY*,⁷ where the protagonist's body dissolves into a semi-solid black structure, while her mind is visualized as micro- and macrocosm flowing into each other. Both types of images portray a singularity, a merger of human and technological intelligence, that eventually becomes its own dimension. This utopian or dystopian scenario of the dissolution of human life into a *posthuman* life-form is visually linked to portrayals of *digital skins*, as can be seen in the works of the Japanese artist Nobumichi Asai.

Picture 2.⁸

Asai explores the possibilities of *digital skins* by using real-time face-tracking and projection mapping technologies in various works, for example the 2014 video installation *Omote*. His work meditates on the aesthetics of digital face projections and the already existing possibilities of real time tracking, which is commonly used in airports and other high security areas to identify and categorize people. Asai seeks to reveal the creative po-

tential of these technologies. He uses technologies of control in order to create a beauty that refers back to traditional Japanese aesthetics, masks and the art of make up as well as to visions of the future in Japanese Manga and animation. A key topos in this work is the mask (Omote), as it is used in Japanese Nō-Theater. The mask that veils a human face is according to Ryosuke Ohashi⁹ the *condition sine qua non* for an actor to be an actor. Only with the mask, the character of the play can gain its own life and inhabit the actor's body. The actor's lived body generates the liveliness of the mask. If we look at Asai's work through the lense of the Nō-Theater, it seems that despite the dissolution of the body into the virtual, the body itself remains a fundamental fact. The mapping devices need the movements and mathematical features of the body in order to create a *digital skin*, a virtual mask.



Picture 3,¹⁰

In science-fiction there is a similar logic to be found in the visualizations of superintelligences or singularities: The dissolution of the human body and mind into a *posthuman* life-form (disembodiment) is often preceded by a process of embodiment.¹¹ The term *digital skin* implies alternate forms of embodiment and poses the question of the importance of the body. *Digital skins* applied to the human body or clothes will alter perception, afford different ways of moving and acting as well as create novel user experiences. *Digital skins* applied to technological artifacts such as robots or prostheses will create a new technological as well as human sense cultures. Sensing abilities of machines converge in the case of artificial limbs with human sensing and will result in alternate sensing habits.

3. The Real and the Virtual in Early Human History and Contemporary Technology

The designer Jenny Lee imagined usages of *digital skin* in her project *Immateriality: The Future Human*.¹² She plays with the idea of how we would change our appearance using *digital skins* just as we now change profile pics or avatars in virtual environments. In fact, future environments might not be categorized any longer by the divide between the virtual vs. the real. As VR devices will gradually become smaller and eventually being integrated in human vision. Perception will become a synthesis of virtual information and "real" perceptual content embedded in one perceptual field. The imminent question is: How will our cognitive setup change with such profound alterations in the aesthetic qualities of the environment? It will be necessary to clarify two things: First: Is this a qualitative new stage of human development or can we find examples for the interwovenness of the real and the virtual prior to digital technology? And second: How can we describe phenomenologically the differences between these states?

In early human history there has been a comparable shift in the way humans perceived the world, which may for the first time have introduced virtual reality into everyday perception: This happened when humans started storytelling. To tell a story means envisioning possible worlds, introducing fiction to reality. The cognitive psychologist Merlin Donald¹³ defines three stages of cultural evolution of human cognition, what he calls the "emergence of symbolizing mentality": The first one is mimetic (gestures, rituals, imitation) starting around 2 million years ago. The second and decisive one here is the mythic stage, the rise of oral culture and narrative thought starting about half a million years ago. The third and very recent stage is according to Donald the theoretic stage (roughly a 1000 years ago), which started with the technology of symbols, with external memory storage via scripture and other means of external storage.

In Donald's theory humans developed their cognitive abilities by becoming *hybrid minds*:¹⁴ Minds that are not self-sufficient but rely on other minds and technology in order to develop the full range of capacities. Accordingly, these *hybrid minds* will change with changing technologies. The well-read mind of a medieval monk will not have dealt with knowledge the same way as digital natives do. There is no biological essence to the human mind, which guarantees its uniqueness. In that sense Donald's theory can be regarded as a *posthumanist* one. Humans have evolved by means that are not of human biological origin but by social and in a fundamental sense technological practices. What is essential to being human is a relative quality of being a *hybrid mind*. Such a theory of human evolution by non-human means has also been described by the French philosopher Bernard Stiegler.¹⁵ While Donald lays emphasis on the forming of cognitive groups, Stiegler theorizes the use of technology (already in the form of measurement of time and use of symbols) as a driving

force in the evolution of human cognition, which he calls *epiphylogenesis* (human evolution by non-human means).

In Donald's second stage (development of the oral culture of storytelling) there has been an increase in activity done in groups, which in his view has been decisive for the human form of cognition: To share attention and intentions, is what gave human cognition its special twist. Already in the phenomenon of shared intentionality there is an intertwining of the real and the virtual at play, because it requires to put oneself in the place of the other, to read the other's mind. The other's mind is by no means visible, it can only be communicated by gesture and language. What one takes as the other's state of mind is in a deep sense virtual, because it is imagined in its affective qualities. With storytelling, the virtual makes it out of human's heads and into the world, Donald speaks of the "virtual realities of oral-mythic culture".¹⁶ Stories do not only tell past events. They either reimagine them or they invent possible or impossible worlds:

Words and grammars are merely the entry-level skills without which narrative traditions could not exist, but once they are acquired, they are secondary to the stories themselves. The cognitive impact of language can be measured primarily through evaluating the cognitive Narratives, especially shared life narratives, are the basis of autobiographical memory itself. Stories and myths can completely reshape our semantic leading to a consensual definition of a shared virtual reality that is the core of oral culture.¹⁷

The virtuality of storytelling implies the formation of mental images. Both in contemporary virtual realities as well as in mental imagery it is the images and not so much the words themselves that are central. This is the reason why I argue that it has been a longstanding practice in human history to fold the virtual into the real. Human hybrid minds have always relied on the *virtual* in the sense that cognition never is realized in autonomous processes:

Collectivity has thus become the essence of human reality. Although we may have the feeling that we do our cognitive work in isolation, we do our most important intellectual work as connected members of cultural networks. This gives our minds a corporate dimension that has been largely ignored until recently.¹⁸

Most of what we are capable of doing and thinking is possible thanks to shared intentions, communication, shared experience and huge variety of technologies. The ability to tell sto-

ries is crucial here, because it enabled humans to abstract from the here and now, to evaluate their doing from a metacognitive perspective. It leads to autobiographic memory and the ability to imagine whole empires, paradises, utopias and dystopias. From the moment of storytelling onward the essential virtuality of the human mind was made explicit. Cultural practices still shape our minds and today we face this unique historical stage, when technology becomes part of our organic setup. Now the second question needs to be reflected, though an ultimate answer is not to be expected: Is there a qualitative change in human perception and cognition to be observed with the advent of digital virtualities permeating the life-worlds of contemporary and future humans?

Today it is digital technology that introduces virtual realities of all kinds into everyday life: be it VR games, images we look at on Instagram or chat messages we write. In those cases, the difference between the virtual and the real remains largely intact. When someone puts on VR glasses she is well aware of the difference this device will create in her perception of the world. She enters a virtual reality and she can leave that reality by lifting the VR device. The concept of *Augmented Reality* gets closer to what I call the folding of the virtual into the real. Though applications like the *Google Glass* have not been successful yet, there are branches of the engineering industry, the military and medicine schools that use such glasses to enhance learning processes and information flow. In those cases, visual and propositional information gets projected directly within the visual field of the user. Real world visuals are enhanced or complemented by virtual projections.

The concept of the *digital skin* goes beyond virtual reality as it exists today. *Digital skins* embed the virtual within the folds of the biological. Our clothes and skin will become semi-technological and *digital skins* also transfer the ability to sense and perceive to artificial limbs, artificial intelligences and even urban environments. The distribution of technological sensing surfaces is a characteristic not only of *digital skins* but becomes a feature of everyday objects and environments. This is precisely what the IoT, *ubiquitous computing* or the *Internet of Everything*, however one prefers to name it are about: Creating spaces with a tightly knit mesh of sensing devices and information flows. In that sense, these spaces resemble *digital skins*. They form surfaces or topologies equipped with sensing capacities. Just like in the case of *digital skins* sensing technologies are already and increasingly will be hidden from view. Today's CCTV cameras might soon resemble dinosaurs. Surveillance technology of the future will probably look more like the tiny glass marbles the movie *The Circle*,¹⁹ that can observe everything without being noticeable. That tendency of technology to become invisible while imposing new regimes of movement, perception and control in urban spaces calls for a phenomenology of these future life-worlds. Instead of using an ecological approach like Luciana Parisi or Erich Hörl,²⁰ I will

suggest a phenomenological approach by using the idea of *digital skins* and combining this with Merleau-Ponty's notion of the *flesh*, a concept of a *generalized sensibility*. The ecological stance focuses purely on relations. Hörl aims at developing a theory of a sense-culture, which fundamentally differs from the historically previous form of a culture that is organized around meaning.²¹ Luciana Parisi coins the term "technoecologies of sensation". Sensing is used to describe distributed processes of human and technological agency. Both approaches do not allow for descriptions of experiences within these changing technological environments. To understand the deep qualitative changes that arise with technological environments we need a philosophical framework that allows for a description of the continuity between the subject and the object, the perceiver and the perceived. Continuity here does not mean sameness or equivalence. The notion of the *flesh* establishes a common ground from which differentiation between perspectives and relationalities can be constituted and understood. My aim is to add an experiential component to contemporary theories of technology and sense culture in order to give a more fine-grained description of new affordances, affects and ethical challenges. With digital technology being inscribed in the body as well as in the life-world we need new conceptual means to describe what consequences arise for human life. To capture these processes, I introduce the hybrid concept of the *digital flesh*. This concept is meant to uncover the generalized sensibility that emerges in the folding of the material, the biological and the digital, as it happens with *digital skins*.

4. Generalizing Sensibility - *The Digital Flesh*

All fashion practices of designing surfaces, appearances and interfaces are ways of tailoring relational potentialities. The way I shape my appearance will influence how I relate to others. The way a city is shaped by architecture and technology shapes how people will interact. Rabari and Storper,²² geographers who research urban planning use the term *digital skin* to describe the mesh of sensors and measuring devices in urban environments. The presence of sensing devices changes urban environments profoundly, because they generalize sensibility. Merleau-Ponty's notion of *the flesh/la chair*, which he developed in his late unfinished writings represents such a *generalized sensibility*. It is meant to be a counter-concept to Cartesian dualism, which separates matter from mind. In the concept of *the flesh* he aims at establishing an integrative account of sensing and being sensed, perceiving and being perceived. The quality of being sensible is shared by human flesh and the perceptual world. This continuity is the condition for perception and cognition. To put it another way: The possibility of being seen or touched is already inscribed in perceptual world:

Flesh of the world, described (apropos of time, space, movement) as segregation, dimensionality, continuation, latency, encroachment. --- [...]That means that my body is made of the same flesh as the world (it is perceived), and moreover that this flesh of my body is shared by the world, the world *reflects* it, encroaches upon it and it encroaches upon the world (the felt [senti] at the same time the culmination of subjectivity and the culmination of materiality), they are in a relation of transgression or of overlapping.²³

The concept of the *flesh* as presented in Merleau-Ponty expands the logic of perception beyond the perceiver. In his view perception is only possible because the perceiver and the perceived share the fact of being perceivable, touchable and embodied. Just as things relate to their surroundings via their material form and perspective so does the perceiver. In the case of human subjects *being embodied* means two things: Being a lived body with sentience and qualitative states as well as having a body that can be an object of perception just as stones, tables or cars.

Thanks to this double-sidedness of the body human perception is deeply intertwined with its environment. This environment is changing profoundly. With digital technology being embedded within the *flesh* of the perceptual world, there is a new form of sensing present: the digital sense culture. This is why I use the term *digital flesh* instead of the Merleau-Pontian notion of *flesh* or *flesh of the world*. The concept of the *digital flesh* focuses on the continuity between human and artificial sensing and is meant to serve as a starting point of a more fine-grained perspective of the experiences involved. Merleau-Ponty holds that being in touch, being related and being embedded within an environment gives rise to higher order cognitive capacities like self-awareness. The concept of the *digital flesh* is meant to describe the depth of the experiential dimension in technological life-worlds. It is directed toward a distributed sense-culture which transcends the dualism of biology and technology and merges digital and biological forms of perception, folds them into each other and creates spaces of new sensations.

Merleau-Ponty's theory of embodied cognition serves as a theoretical starting point for contemporary theories of embodied, embedded, enacted and extended cognition. A common ground of this diverse set of theories is that cognition is not brain-bound, hence is being facilitated by the body, the environment as well as through media that store knowledge and distribute information. The way we interact with digital media shapes how memory is stored and knowledge is communicated. With the emergence of *infrastructural intelligence*, human perception increasingly depends on the logic and algorithms of intelligent technolo-

gies, because these technologies function on different timescales than human perception and are designed to predict the needs of the user. That means the technology we are surrounded by creates a topology of interconnected sensing devices whose algorithms are trained to serve information even before it is requested.

Timothy S. Barker described this peculiar situation in a talk as living in the *aftermath* of the technological time. It is precisely this situation, that human perception is deeply influenced by technological processes that occur beyond conscious perception that calls for an effort to understand the quality of those changes. If technological permeated environments are understood as a dimension of ubiquitous sensing it makes sense to go for a phenomenological analysis of the intentional relations between the different ways of sensing as well as the mergers of human and artificial sensing. Such an endeavor can only partly rely on strict phenomenological method, there will be complexities and difficulties in understanding artificial sensing processes that require experiment and interdisciplinary work. Hence, the conceptual framework needs to be sharpened in co-operation with experiments in conceptual fashion and digital art. Fashion plays a twofold role here: It promotes innovation that transforms our bodily experience and relation to technology. But fashion has also the means of critical reflection with regard to the folding process of digital and biological sensing. Fashion in this regard is not only interesting because it generated the concept of the *digital skin*. It is a unique sector in which a long history of designing and shaping bodies meets with a creative take on existing and future technologies that are applied to the artifacts as well as to the bodies of the wearer/user. Fashion is closely related to technological innovation, as can be seen in the examples mentioned above. This proximity to science makes fashion a communicator of new technologies. There is both the potential in fashion to uncritically distribute technologies that contribute to the existing control society as well as the possibility to experiment and critically reflect on the use and development of future technologies. This is the reason why a collaboration of philosophy and especially conceptual fashion can be a productive way to engage in a meaningful discourse on changing life-worlds and technological environments.

¹ Johannes Bruder, "Infrastructural intelligence: Contemporary entanglements between neuroscience and AI." In: T. Mahfoud, S. McLean and N. Rose (eds.), *Progress in Brain Research*, Vol. 233. Academic Press, Amsterdam 2017, pp. 101-128.

² Spike Jonzes, *Her*, USA, 2013.

³ Jennifer Phang, *Advantageous*, USA, 2015.

⁴ See: <https://www.dezeen.com/2013/12/11/wearable-solar-fashion-by-pauline-van-dongen>

⁵ Yvonne Förster. "The Body as Medium – Fashion as Art." In: I. Deretic, S. L. Sorgner (eds.), *From Humanism to Meta-, Post- and Transhumanism?* Peter Lang, Frankfurt/M. 2016b, pp. 321-332.

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- ⁶ Wally Pfister, *Transcendence*, USA, 2014.
- ⁷ Luc Besson, *Lucy*, France, 2014.
- ⁸ Screenshot from video, 22.03.2018
- ⁹ Ryosuke Ohashi, Kire. *Das Schöne in Japan*, Wilhelm Fink Verlag, Paderborn 2014.
- ¹⁰ (<https://www.nobumichiasai.com/post/138919147877/omote-real-time-face-tracking-projection>, 22.03.2018)
- ¹¹ Yvonne Förster, “Singularities and Superintelligence: Transcending the Human in Contemporary Cinema.” In: *Trans-Humanities*, Ewha Institute for the Humanities (EIH), Seoul 2016a, pp. 33-50.
- ¹² Jennifer Lee, *Immateriality: The Future Human*, 2011.
- ¹³ Merlin Donald, *A Mind So Rare: The Evolution of Human Consciousness*. W.W. Norton & Co, New York 2001.
- ¹⁴ *Ibid.*, p. 252.
- ¹⁵ Bernard Stiegler. *Technics and Time, 1: The Fault of Epimetheus*, Stanford University Press, Stanford 1998.
- ¹⁶ Donald, 2001, p. 295.
- ¹⁷ *Ibid.*, p. 296.
- ¹⁸ *Ibid.*, p. 298.
- ¹⁹ James Ponsoldt, *The Circle*, USA, 2017.
- ²⁰ Luciana Parisi, “Technoecologies of Sensation.” In: *Deleuze | Guattari & Ecologies*, B. Herzogenrath (ed.), Palgrave, New York 2009, pp. 182–99; Erich Hörl, “A thousand ecologies: the process of cyberneticization and general ecology.” In: *Modern Language Notes* 123, 2008, pp. 194-217.
- ²¹ Hörl 2008, p. 125.
- ²² Chirag Rabari, Michael Storper, “The digital skin of cities: urban theory and research in the age of the sensed and metered city, ubiquitous computing and big data.” In: *Cambridge J Regions Econ Soc* 2015; 8 (1), pp. 27-42. <https://doi.org/10.1093/cjres/rsu021>
- ²³ Maurice Merleau-Ponty, *The Visible and the Invisible*. Northwestern University Studies, Evanston 1969, p. 248.

References

- Johannes Bruder, “Infrastructural intelligence: Contemporary entanglements between neuroscience and AI.” In: T. Mahfo-ud, S. McLean and N. Rose (eds.), *Progress in Brain Research*, Vol. 233. Academic Press, Amsterdam 2017, pp. 101-128.
- Merlin Donald, *A Mind So Rare: The Evolution of Human Consciousness*. W.W. Norton & Co, New York 2001.
- Yvonne Förster, “Singularities and Superintelligence: Transcending the Human in Contemporary Cinema.” In: *Trans-Humanities*, Ewha Institute for the Humanities (EIH), Seoul 2016a, pp. 33-50.
- Yvonne Förster. “The Body as Medium – Fashion as Art.” In: I. Deretic, S. L. Sorgner (eds.), *From Humanism to Meta-, Post- and Transhumanism?* Peter Lang, Frankfurt/M. 2016b, pp. 321-332.
- Erich Hörl, “A thousand ecologies: the process of cyberneticization and general ecology.” In: *Modern Language Notes* 123, 2008, pp. 194-217.
- Celia Lury, Luciana Parisi, Tiziana Terranova, “Introduction: The Becoming Topological of Culture.” In: *Theory, Culture & Society* 29, 2012, pp. 3–35. <https://doi.org/10.1177/0263276412454552>
- Maurice Merleau-Ponty, *The Visible and the Invisible*. Northwestern University Studies, Evanston 1969.
- Akihito Miyamoto a.o., “Inflammation-free, gas-permeable, lightweight, stretchable on-skin electronics with nanomeshes.” In: *Nature Nano*, advance online publication. JOUR, 2017. <http://dx.doi.org/10.1038/nnano.2017.125>
- Ryosuke Ohashi, Kire. *Das Schöne in Japan*, Wilhelm Fink Verlag, Paderborn 2014.

Luciana Parisi, “Technoecologies of Sensation.” In: Deleuze | Guattari & Ecologies, B. Herzogenrath (ed.), Palgrave, New York 2009, pp. 182–99.

Chirag Rabari, Michael Storper, “The digital skin of cities: urban theory and research in the age of the sensed and metered city, ubiquitous computing and big data.” In: Cambridge J Regions Econ Soc 2015; 8 (1), pp. 27-42.
<https://doi.org/10.1093/cjres/rsu021>

Bernard Stiegler. *Technics and Time, 1: The Fault of Epimetheus*, Stanford University Press, Stanford 1998.

Movies

Spike Jonzes, *Her*, USA, 2013.

Luc Besson, *Lucy*, France, 2014.

Wally Pfister, *Transcendence*, USA, 2014.

Jennifer Phang, *Advantageous*, USA, 2015.

James Ponsoldt, *The Circle*, USA, 2017.

Fashion Shows and Artworks

Viktor&Rolf, *Bluescreen*, FW 2002/03.

Jennifer Lee, *Immateriality: The Future Human*, 2011.

Nobumichi Asai, *Omote*, 2014.