

Nigredo: configuring human and technological bodies

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1 Introduction

In the preface to his work *The Body and Social Theory*² [Shilling, 2012], British sociologist Chris Shilling explains how, in recent decades, the human body has become a popular matter of interest thanks to the advance in transplant surgery, stem-cell research and reproductive technology, and the public disputations over neuroscience claims and radical bodily modifications. Then he asks, “[h]ave we lost or gained control over our bodily identities, properties and capacities?” [Shilling, 2012, p. ix]. It is a sharp question, because it prompts for a reflection on distinct yet interrelated notions. More specifically, what does control over one’s bodily identity mean? Do we control our body properties, or are they controlled by the media that condition the body in the first place? In our physical interaction with technology, are our body capacities the object or the subject of the action? The answer lies in understanding human subjectivity and technological individuality as two sides of the same iterative process. Human beings create technological artefacts which influence the formation of human subjectivity. In turn, the shifting characterization of human subjectivity prompts new directions for technical development. It is a self-organizational feedback loop. From this viewpoint, we can move beyond the idea where identity is controlled, and embrace a notion where human subjectivity emerges through the configuration of human bodies with technological bodies. *The term “configuration” will be used in this chapter to indicate not a*

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² The first edition was published in 1993.

mere pairing of machine and human bodies, but their arrangement in particular forms and for specific purposes. The configuration of the human and the machine is not intended at a metaphysical level, but at a practical one. Biomedical technologies have provided us with an entry point to a still largely unexplored territory where human and technological bodies are pieced together. DNA cells are used to do computations in test tubes, the entire human genome heritage is stored and categorized in digital databases accessible via the Web, artificial organs replace malfunctioning human organs, physiological signals are channelled through the circuits of robotic prostheses that restore human bodies. It would be ingenuous to overlook the markedly cultural and political impact of such configurations.

How can we discuss critically the configuration of humans and machines at a cultural and political level?

How can such understanding inform the way artists design technological instruments and the related performance strategies?

According to Italian/Australian feminist philosopher Rosi Braidotti, we live in a global economy where nanotechnology, biotechnology, information technology and cognitive sciences are converging into new capitalistic strategies. What Braidotti calls “advanced capitalism” aims to accumulate profits by investing in the “commodification of all that lives” [Braidotti, 2013, p. 59]. This includes genomic research on human beings, plants and animals, and biotechnological intervention, but also the trade of information databases by multinational corporations such as Facebook. As a result of this convergence of capitalist strategies and life-mining technologies, the human subject for Braidotti is “technologically mediated to an unprecedented degree” in ways that erase the tight boundaries that humanism had set around “Man” as a unitary being [Braidotti, 2013, p. 57]. For Braidotti, this condition “urges” us to conceive creatively and critically of human subjectivity as the expression of a process of becoming that embraces human and nonhuman life, living matter and nonliving [Braidotti, 2013, p. 12].

Nigredo, the artwork that will be discussed here, re-appropriates biologically informed computational methods towards a critical questioning of the formation of human subjectivity. The work questions the role of computational technologies in the formation of human beings in the era of the commodification of all that lives. This is done by delving into the relations amongst *transindividuation*, *bodily performativity* and *biomediation*, cultural notions that permeate the technological and political domains. Those notions will be presented and used to discuss the artwork. This posits the idea that we do not possess a static identity, but rather that identity is emergent from the dynamic configurations of

human and technological bodies. In the remainder of this chapter it will be discussed how *Nigredo* reifies a condition of mutual codependence where the human and the machine bodies perform each other by exchanging acoustic energy.

2 Visceral sounds

Developed at STEIM, in collaboration with artist and engineer Marije Baalman, *Nigredo* is a private eight-minute artwork to be experienced by one visitor at a time. The work is presented in the form of a time-based installation. By repurposing *biofeedback* methods, *whole-body vibration* and wearable *bioacoustic* technology, the visitor is first induced into a state of perceptual deprivation, and then subjected to diverse stimulations designed and temporally composed so to provoke physiological, physical and neural alterations. The work aims to unlock latent qualities of the human body through its coupling with the technological system.

Biofeedback is a technique that makes internal bodily mechanisms, that would otherwise be imperceptible, become manifest as audio or visual data [Moss, 1998]. By using analogue and digital sensors it is possible to track electrical and acoustic signals from the human body and then transform those signals into visual (visualization) or auditive information (sonification). Whereas it is mostly used for medical applications in the field of neural and locomotive rehabilitation, there exists a long history of biofeedback applications to music and performance art (see Donnarumma [2012a]).

Whole-body vibration refers to the exposure of a human body to externally induced mechanical vibrations, generally by means of high-power infrasound devices. In the same way as all inorganic structures, the human body resonates with mechanical vibrations, and at specific frequencies it is possible to provoke maximum mechanical response [Griffin and Seidel, 2011]. Externally induced vibrations at an adequate amplitude are known to produce displacements of human organs and the organic structure of the body [Lowry and Bosley, 1962]. This creates diverse effects, from simple discomfort, to interference of the acquisition of sensory information, decision-making processes and memory, and physiological changes, including cardiovascular and respiratory alterations [Griffin and Seidel, 2011].

Bioacoustics is the study of the sound produced by the vital processes of living creatures; in this case, the installation uses low-frequency sounds produced by the internal organs of the visitor's body. These sounds include blood flow pulsations, heartbeat and muscle sounds (also known as the mechanomyogram or MMG). Similarly to the blood flow pulsations, the MMG is a low-frequency vibration. Rather than being produced by the movement



of the blood flowing in the veinous system, MMG signals are generated by subcutaneous mechanical vibrations resulting from muscle contraction. When a muscle receives an action potential,³ it contracts and changes shape. This dimensional change produces subsequent vibrations that propagate to the skin surface and cause the skin to vibrate. The skin vibrations produce longitudinal pressure waves; these constitute the MMG signal. It is exactly the same process that generates what is commonly recognized as the “heartbeat”, that is but the sound of the heart muscles extending and contracting. The MMG can be captured with accelerometer sensors [Islam et al., 2013] and, as in the case of this work, using wideband surface microphones [Oster and Jaffe, 1980]. Using a microphone on the skin above a muscle group it is possible to record the MMG produced by perturbations of the limb surface. The signal energy lies in the 2–45 Hz range. The MMG is a permanent signal, that is, it does not require external stimulation, and it is graded, meaning that its activity spans over a

3 The action potential is an electrical impulse sent from the central nervous system to the muscle cells to trigger a contraction of the tissues.



Fig. 1. One of the visitors sitting in the installation booth. The LED lights illuminate the right-hand side at periodic intervals according to the breathing rate captured by a sensor located on the chest of the visitor.

dynamic amplitude range. The MMG mirrors muscle mechanical activity and its amplitude is proportional to the strength of the contraction [Barry et al., 1992]. The systematic study and recording of the MMG started around the 1980s [Oster and Jaffe, 1980], and the signal is mostly used in physiology, prosthetics, biomechanics and motor behaviour, and sport studies. Its applications include specification of neuromuscular disorders, muscle characterization, prosthesis and rehabilitation devices development, analysis of motor unit activity and the body's mechanical properties during exercise [Islam et al., 2013]. The MMG signal is rich in information and contains low baseline noise; however, it is not local and sensitive to peripheral movements. Besides, no international standard for its analysis seems to exist yet. Yet, there are qualities of the MMG that make it ideal for applications in the setting of a public installation, namely: (a) as a mechanical signal, it is tracked more easily from diverse human bodies if compared to other physiological electric signals that

require precise calibration; (b) it bears trial-to-trial consistency in different environmental conditions; (c) it is not sensitive to electromagnetic interference that can be caused by other devices either worn by the visitor or present in the installation space.

Several times in this chapter the blood flow pulsations, the heartbeat and the MMG are referred to as *sounds*. Even though some may argue for a different interpretation of what a sound is, it is natural to use the term in this context, for, as a matter of fact, the vibrations produced by the human body are acoustic oscillations. As such, they can be amplified and heard through loudspeakers, or captured and processed using a computer. Departing from that simple observation, in 2010 I created a musical instrument capable of capturing those visceral sounds and using them as musical material to be processed using real-time custom algorithms. The instrument, called *Xth Sense*,⁴ is composed of a custom wearable biosensor and an ad hoc computational engine. The biosensor is a contactless microphone embedded in a wearable armband which can be placed on any part of the human body. The microphone captures the low-frequency vibrations of blood flow, heartbeat and muscles in the form of an acoustic sound. Once that sound is captured, it is sent to the software which first processes it using live sampling algorithms, and then outputs the resulting sound forms. The live sampling is driven by a mathematical model of the performer's muscle activity, which is computed by extracting features from the same sounds captured by the microphone sensor [Donnarumma, 2012b]. This simple yet effective strategy enables a diverse range of real-time interactive applications, ranging from musical performances to multimedia dance and action art pieces.⁵ In *Nigredo*, the instrument has been repurposed so as to be used in combination with high-power infrasound devices and create a physical link between the human and the technological bodies.

3 Human parts and machine parts

Accompanied by an assistant, a visitor enters a very small and completely blackened booth. Here the visitor is invited to sit on a chair facing a one-way mirror. The chair is embedded with three high-power infrasound devices that make direct contact with the visitor's skull and vertebral column. The assistant requests the visitor to take off shoes and shirt, then blocks the skull of the visitor to the chair using an elastic headband and helps the visitor to wear a *Xth Sense* biosensor at the location nearest to the heart.⁶ The biosensor captures the

4 *The Xth Sense* is an open-source and free biotechnological system for interactive music performance and responsive milieu used today by a growing community of thousands of practitioners worldwide. Its hardware and the related documentation are licensed under a Creative Commons Attribution Share-Alike licence and the software code is released as free software under a GPL licence.

5 Several examples can be viewed online at <http://marcodonnarumma.com>

6 In the case where the visitor does not wish to take off shirt and shoes, the assistant politely guides the visitor out of the installation space.

sound of the visitor's heartbeat, blood flow and muscle contractions. The sound is digitally processed and fed back to the visitor's body in the form of new audio, visual and physical stimuli. Namely, sounds are diffused by a hidden surround system and two subwoofers, flickering lights are generated by LED strips located behind the visitor's body, while intense mechanical vibrations are induced to the whole body using the high-power infrasound devices. By executing a temporal composition of auditive, light and vibrational stimuli in different combinations and intensities, the system creates a saturated stimulation field that induces in the visitor's body a state of perceptual deprivation. In this state, the human body is not able to make a meaningful grouping of internal and external stimuli and thus the neurophysiological processes that drive the perception of both the environment and one's own body are altered [Rasmussen, 2007, pp. 9–11]. The awareness distinction between what is part of one's self and what is seemingly not is blurred. It is an intimate and uncanny experience of one's inner self.

In stark contrast with the long-established applications of sensory and perceptual deprivation for the development of torture and confinement techniques (see Shurley [1992]; Rejali [2003]), perceptual deprivation is used in *Nigredo* as a means to unlock the *potential* of the human body for different modes of operation. The term "potential" is intended here as in the work of Canadian critical theorist Brian Massumi, that is, a latent quality or ability of a (living or nonliving) body that may be or may not be developed. According to Massumi, a body's potentials are independent and discontinuous until they move beyond a "threshold" [Massumi, 1995, p. 95] and become actualized. When this happens, the body acquires new modes of operation. Massumi exemplifies the idea of threshold by recalling an optical illusion. Most optical illusions require the viewer to stare at an image for a short time before the effect actually "appears". The image has not changed, but the excess of the visual input has made one's vision surpass a given threshold. In this way, despite the image being still the same, it is perceived as a new one. Massumi argues that, in a similar way, the human body potentials, that is, the latent abilities and qualities of a human body, are developed only when they surpass a given threshold [Boever et al., 2009]. In the same way, *Nigredo* produces an excess of sensorial information so that one's self perception surpasses its threshold, and latent potentials are realized.

This understanding of human potentials and their dynamic thresholds is at the heart of the process of individuation and transindividuation. Individuation is the biological, psychological and social process whereby an individual develops specific physical and behavioural features. French philosopher Gilbert Simondon has discussed individuation extensively, formulating his argument around the key concepts of reflexivity and open



endedness. According to Simondon, individuation is a feature of both human beings and physical phenomena [Simondon, 1992, p. 302]. For instance, he exemplifies his notion of human individuation taking as a model the physical individuation of crystals, that is, the process of crystallization [Simondon, 1992, pp. 302–305]. He considers a supersaturated solution which has a metastable equilibrium.⁷ The solution yields different energy and density levels that, when organized, originate individual crystals. The crystals are not actually present in the solution, but their potential is. In other words, the potential for diverse crystals to emerge from the solution constitutes the solution itself. Turning back to the individuation of living beings, Simondon states that the same model characterizes

⁷ Metastable, in Simondon's idiom, stands for a primal condition of matter, namely, an unstable equilibrium which is possible thanks to manifold levels of energy in tension amongst each other, that, once organized, produce an individual.



Fig. 2. Detail of a visitor's skull blocked against one of the infrasound devices using an elastic headband. It is necessary to block the visitor's skull otherwise the mechanical vibrations of the high-power infrasound device can be harmful.

human individuation, with the important difference that, unlike physical individuation, which is “definitive” [Simondon, 1992, p. 304], human individuation does not exhaust in one iteration. Rather, it is “an activity of permanent individuation” [Simondon, 1992, p. 305], which he calls “becoming” [Simondon, 1992, p. 301]. For Simondon the process of individuation not only brings the individual into being, but it also defines the way it develops, organizes and acts. Through individuation the individual restructures itself. Therefore, the individual “does not represent the totality of being” because it is “merely the result of a phase in the being’s development” [Simondon, 1992, p. 300]. In this sense, the process of individuation is a “partial and relative resolution” continually operating through the “latent potentials” that the individual holds [Simondon, 1992, p. 300] in what

Simondon calls the ‘pre-individual’. The completion of one cycle of individuation does not exhaust all the potentials of the pre-individual, rather a potential is always present and feeds subsequent processes of individuation [Simondon, 1992, p. 306].

Through the lens of Simondon’s processual approach, human subjectivity is never complete because a subject’s potential self is developed iteratively in conjunction with others. The term “others” refers here to both living and nonliving beings, and thus hints at a constructive interaction of human and machine technology. For Simondon, in fact, individuation also happens at the social level – when individuals forming a collective entity establish relations among themselves that individuate their group, and at a technical level – where the individuation of an individual draws from interaction with technical systems. This is a process that he calls *transindividuation* [Simondon, 1989]. The notion of transindividuation constitutes the conceptual foundation of *Nigredo*. The work however is not a simple observation of the notion, but rather a practical actualization of it. By creating a system that can only function through the codependence of a human body and a technological one in a perceptually saturated space, the work aims to forcefully create alternative connections between the constituting parts of the organic and the machinic bodies. The sounds of vital and physiological processes of the human body are magnified so to make the latter (literally) resonate with the parts of the technological system. The supposed separation of the individual from living and technological others is put into question.

Borrowing from French philosopher Bernard Stiegler, this approach shows the body as “toujours inachevé” [Stiegler, 2011a], always unfinished. For Stiegler, the individual is always in a process of becoming rather than in a defined condition; as he explains, “[u]n individu est un verbe infinitif plutôt qu’un substantif défini, un devenir plutôt qu’un état”⁸ [Stiegler, 2011b]. From here, Stiegler expands on Simondon’s transindividuation and defines it as a three-stranded process, that is always at the same time psychic, collective and technical. For Stiegler, psychic individuation is the formation process of the individual, what he calls the “I”; collective individuation is the formation process of a group of individuals, the “We”; and technical individuation is the formation of the “technical milieu” that connect the “I” to the “We” [Stiegler, 2011b]. The term “technical” for Stiegler is a synonym of a constellation of technologies, technical skills and technological models. The term “milieu” is intended by Stiegler as both what is around the individual (i.e. the environment) and what is between individuals (the medium). The notion of “technical milieu” is crucial to the understanding of *Nigredo* because it renders technological systems as both constituted by and constituent of human individuation.

8 “An individual is an infinitive verb rather than a noun, a becoming rather than a condition.” Translation by the author.

From this perspective, the tangible parts of the machines that the installation is made of, that is, its machinic sensors, transducers and computing circuits, can be seen as “artificial organs” [Stiegler, 2011a]. This makes it possible to think of alternative modalities of embodiment, tangible instantiations of living bodies where the organic and the machinic co-exist and perform each other through the extension and configuration of their parts.

4 Alternative embodiment

The experience of *Nigredo* unfolds during three phases. The first phase forces the visitor to concentrate on self perception through sound and light. As the assistant leaves the booth and the visitor sits down, the bioacoustic sound of the heartbeat, blood flow and muscle contraction is captured and played back by the hidden surround system and the two subwoofers. The one-way mirror in front of the visitor is not visible yet due to the complete darkness inside the booth. Two minutes after, LED strips placed vertically along two of the room walls synchronize with the pulsations of the visitor’s visceral sounds and light up rhythmically, thus enacting a simple biofeedback mechanism. At this point, the visitor’s heartbeat is recorded and digitally processed so to sound increasingly faster. This is followed by an increase in the light intensity and flickering rate. Over a three-minute climax, the heartbeat together with the sound pulses of blood and muscles are digitally processed and fed back to the subject’s sensory system as increasingly intense auditive and light stimuli. The natural low-frequency sound of the visitor’s heartbeat, blood and muscles is digitally stretched into progressively shorter samples, that eventually result in a thick and harsh layer of sound sitting between 200 Hz and 18 kHz. One’s vital rhythm is digitally augmented by the machine so to form another tangible form of the self. The biological medium becomes the source of a hybrid self-perceptive narrative.

The second phase is a transitional moment where the visitor’s vision of her own body is altered. As soon as the sound pressure level (SPL) exceeds 120 dB, thus getting closer to the threshold of pain,⁹ the light flickering rate becomes almost continuous and a separate LED light synchronizes with the visitor’s breathing rate illuminating the one-way mirror at periodic intervals. Suddenly the harsh sound stops and the visitor can only hear a quiet sine wave at 600 Hz. Because of the sensory shock caused by the sudden drop from a very high to a very low SPL, the fast flickering of the LED lights and the visual distortions produced by the one-way mirror, the visitor’s vision is altered, making her unable to recognize the image in the mirror as her own. This altered state is forced onto the visitor’s sensory system for one minute.

⁹ The threshold of pain is commonly understood to sit around 130 dB.



In the third and final phase, the visitor's and the system bodies are physically coupled and a new perception of one's self arises. The sine wave stops and the visitor's bodily sounds are spatialized in the booth in the form of a subtle soundscape flowing around the head of the visitor. The three high-power infrasound devices embedded in the chair are suddenly activated. By making direct contact with the skull and the vertebral column, the devices feed back to the visitor's body her own visceral sounds in the form of mechanical vibration patterns. The different patterns are designed so to travel through the body in opposite directions and thus create standing waves inside the visitor's rib cage. A standing wave is a stationary wave that is produced by the encounter of two waves travelling in opposite directions and so induces resonance in a medium, in this case a human body. Because the standing wave is a strong stationary acoustic vibration, it resonates internally the bones and



Fig. 3. One of the high-power infrasound devices embedded in the chair inside the installation booth. By making three of these devices directly touch the protuberances of the visitor's vertebral column and skull, intense acoustic energy is created inside the head and rib cage, thus displacing one's internal organs.

the tissues, and thus displaces the relative position of one's body organs [Griffin and Seidel, 2011]. The combination of intense whole-body vibration, spatialized auditive stimuli and flickering lights interferes with the neurophysiological processes that govern the voluntary and autonomic nervous systems. This alters the rhythm of the cardiovascular and respiratory system, the perception of one's own articulations in space and the behaviour of the optical nerves [Rejali, 2003]. The perception of one's own image in the mirror mutates and with it also the perception of one's own body changes. At last, the frequencies of the infrasound devices increase in unison until the installation is abruptly interrupted. The visitor is left in complete darkness and silence for one minute, and then the assistant enters the booth and lets the visitor out.

At the premiere of *Nigredo* at STEIM during the Sonic Acts Festival, Amsterdam in March 2013, the participants were interviewed as soon as they left the installation in order to gain first-hand insights in the way the installation was experienced by diverse individuals.¹⁰ The typical effects they reported ranged from blurred vision and loss of equilibrium, to a sense of falling or being touched, amongst the others. Several participants had difficulties in remembering and recounting the experience immediately after they left the booth. Individual experiences were very different, with a participant reporting she felt like in a “cosmos”, another uncomfortably outlining she felt “invaded and watched” and another explaining that the installation had changed his “way of experiencing [the world]”. What is common to all their accounts is a reference to an unfamiliar experience of their bodies. Some potentials were unlocked. The awareness of their embodiment was altered and extended in ways that they were not able to process through rational reasoning nor to express fully in words. Yet, their feelings were reified by a markedly new bodily experience.

Nigredo enables alternative modalities of embodiment by allowing the intermix of the informational codes yielded by the human and the technological bodies. This argument can be clarified by looking at the work of American literary critic Katherine N. Hayles [Hayles, 1999]. Hayles has elaborated on a view where human beings and machines develop together through their mutual interaction, what she calls the “posthuman”.¹¹ Her discourse begins with the premise that the meaning of “embodiment” – that is, the tangible manifestation of a living or a nonliving organism – is twofold. On one hand, embodiment signifies the “material instantiation” of an organism in a context; on the other, it signifies the “informational pattern” that an organism yields [Hayles, 1999, p. 2]. In this sense, she argues that a human being and a piece of code are both embodied. This is because they are both situated, that is, their existence is meaningful in a specific context be it a city or a computer. Secondly, they both yield and share informational patterns. For Hayles, human beings and machines share informational patterns through their mutual interaction and, in so doing, they constitute each other’s modalities of embodiment.

10 A video using actual footage and interviews is available at the author’s online portfolio at <http://marcodonnarumma.com/works/nigredo>.

11 The posthuman has been a subject of interest for several authors. For the sake of the argument in this chapter the work of Hayles is the only one examined in detail. Donna Haraway has looked at how the boundaries of what we used to define human have become increasingly blurred. In her view, the posthuman discourse produces unclear distinctions amongst humans, machines and animals that can be used to foster a new understanding of gender and species [Haraway, 1991]. Ollivier Dyens has argued that through the entanglement of human biology, information and machines the boundaries between organic and inorganic become interlaced in ways that make the human subject disembodied in a cultural system that integrates biology, art and artefacts [Dyens, 2001]. Mark B. N. Hansen has looked at phenomenological issues in virtual reality to argue against the idea of human disembodiment through technologies, and rather affirm the human extended embodiment through mixed realities, which include both the real and cyberspace [Hansen, 2006].

From this viewpoint, *Nigredo* can be described, borrowing Hayles's idiom, as an "amalgam" of different components, "a material-informational" body that is unbounded because it develops through "continuous construction and reconstruction" of diverse forms of embodiment [Hayles, 1999, p. 3]. *Nigredo* enacts a perceptual and physical feedback loop that can only exist through the integration of the human and the technological bodies. And, the experience can only exist in the moment when the integration is realized. The output of the installation is tangibly experienced by the subject through the mechanical resonance of flesh, bones and skull. However, the experience is not only physical. By impacting the human body with a stimulation field that greatly exceeds the limits of everyday human experience in the natural world, the inner workings of the human body are disrupted and inhibited. In so doing, the boundaries of one's corporeal awareness are loosened and confused so that the human body does not recognize the stimuli produced by the machine as external input, but rather it processes them as part of its internal states. The body and the machine share openly informational code. In other words, by transforming the natural pulsation of the human body into new internal states, *the technical system and the human body become active parts of a new body, one that integrates them into one emerging entity*. The human and the machine bodies become a constituting part of each other. It is an experience that takes place in between viscera and circuits, flesh and sound.

This notion is exemplified by Hayles's understanding of the human body as a prosthesis. In her view, the human body is the "original prosthesis" [Hayles, 1999, p. 3], which we all learn to operate since birth. Later, through the coupling with technology, the posthuman subject learns to extend itself using different prostheses; human bodies are virtually extended through computers and avatars, physically modified through prosthetic limbs and internal organs, and genetically categorized and manipulated through genomic research. In Hayles's view, the posthuman subject should be understood as unbounded because it is capable of continually "extending [(its)] embodied awareness" [Hayles, 1999, p. 291] through the coupling and co-existence with machines. *Nigredo* reifies such co-existence by physically coupling the visitor's flesh and bones with machinic receptors and transducers. It is the mediation of organic and technological media as elements existing at the same ontological level and thus capable of producing themselves through the hybridation of their operational models.

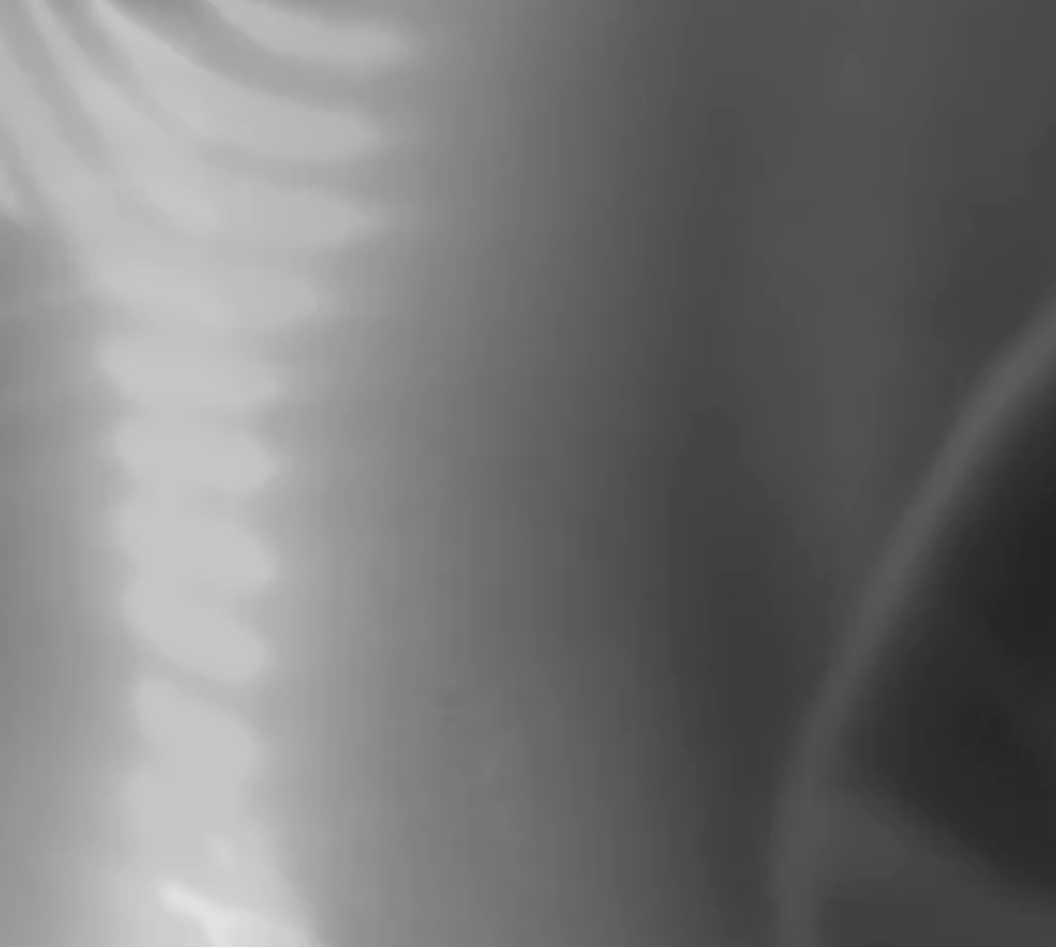


Fig. 4. Detail of the image of a visitor reflected in the one-way mirror during the installation. The picture shows how a visitor experiences the image of her own body during the installation.

5 Matter of mediation

The interplay of humans and machines, of bodily and nonorganic matter goes beyond the ontological plane. American sociologist and philosopher Patricia Clough argues for a relational approach. Clough's argument serves well to the understanding of *Nigredo* because it is situated in the current landscape of biological technological media. She defines two technological media, biomedica and new media [Clough, 2008, p. 2]. Biomedica are intended by Clough as the technologies that enable the mass production of genetic material, and the technologies that act upon or draw from biological data. New media include for Clough those digitization technologies that expand the human senses. The interaction of bodily



matter and nonliving matter with biomedicine and new media is what Clough defines as *biomediation*. In her words, biomediation is characterized by the capacity of biomedicine and new media to “attach to and expand the informational substrate of bodily matter and matter generally” [Clough, 2008, p. 2].

Biomediation can also extend biology itself. According to American media theorist Eugene Thacker, biomediation allows us to use biology beyond its own limits while maintaining its biological features [Thacker, 2004, pp. 14–15]. Thacker makes two examples; one is biocomputing, where DNA molecules are used to perform computation in test tubes, and the other is bioinformatics, where DNA is treated as information, and thus digitized, categorized and archived into databases [Thacker, 2004, p. 4]. In both examples the process of biomediation produces a view of biology such that it is not ontologically separate from

the technical medium, but rather it *is* the technical medium. This is a fundamental aspect of *Nigredo*, that is, the biological features of a human body are the technical medium. The human body becomes an informational body without compromising its embodied nature. By making biology become both the source and the medium of technological operations [Thacker, 2004, p. 201], *Nigredo* finalizes the merging of biological and inorganic bodies into what Thacker describes as one self-organizational entity [Thacker, 2003]. This allows both organic and nonorganic matter to maintain their autonomy while codepending on each other in the production of themselves. Drawing on Spinoza, Clough refers to this capacity as *affect*. In this view, affect is what connects ontologically bodily matter and nonliving matter.

In *Nigredo*, the organic and the machinic are physically linked through a process of biomediation that produces both anew. When the visceral sound emitted by the visitor's body is registered and digitalized by the machine receptors it becomes a variable that defines the operational code of the machine itself. The sound is then digitally processed and diffused back in the space, thus becoming tangible energy that feeds back into the same body it has originated from through ears, skin and muscle sensory receptors. The sound processed by the technical system makes the visitor's muscular tissues resonate, establishing a physical nexus between the machine and the human body. The visitor's and the machine's bodies resonate synchronously out of the same acoustic energy. From another viewpoint, the visitor's proprioceptive dimension is magnified so that it embraces both the human and the technological bodies. The flesh vibrational force becomes a vector of affect. Because of its position *in between* cognition and viscera, affect is autonomous and unactualized. For Massumi, affect is not an object relegated within the body tissues, rather it "escapes confinement in the particular body whose vitality, or potential for interaction, it is" [Massumi, 1995, p. 96]. In *Nigredo*, affect expands beyond the boundaries of the visitor's body in which it originates, it becomes an integral part of the operational code of the technical system and gives rise to a feedback loop where the human and the machine bodies perform each other and produce a new body.

6 Conclusion: so how does it feel to be human?

The scope of this chapter has been twofold. On one hand, it has aimed to discuss critically the integration of human and machine at a cultural and political level. On the other, the goal has been to show how such understanding can inform the way sound and computational technologies are designed and deployed in the arts. Towards this end, the discussion has looked at *Nigredo*, a private installation of altered-self perception, through the lens of

three key concepts: transindividuation, bodily performativity and biomediation. This has led us to touch upon diverse, yet interrelated, areas, such as philosophies of human and technical individuation, technological posthumanism, theories of embodiment and affect. Along this journey we have encountered visceral sounds, latent potentials, artificial organs and material–informational bodies. Rather than a mere acknowledgement of the current integration of human and machine, this chapter aimed to emphasize human and machinic bodies as highly configurable means to investigate modes of artistic expression with sound technologies. The focus on sound, as both auditive and palpable impulse, as main medium is not casual. Sound is physical matter capable of infiltrating and conditioning both human bodies and technological ones. As such, sound exists in a space in between human and machine bodies or, better, it is the medium they are immersed in and communicate through. In other words, sound provides an active connection through which human and machine interaction is made meaningful.

Another point that was made throughout the text is that the human body develops biologically, physically and cognitively through the intermixing with other (organic or machinic) bodies in an iterative process of becoming. This is not a unidirectional process. As technical artefacts are an active part of human individuation, humans actively contribute to the technical individuation of the artefacts. From this iterative process, a new body emerges; this is a living instance made of human and technological bodies that have been “taken apart and put together”, as American feminist writer Donna Haraway aptly puts it [Haraway, 2003, p. 8]. As noted on different occasions in this text, such idea is not speculative but rather practical. The advance of biotechnology for implants, stem engineering, everyday biometrics and wearable technologies is but a proof of such new bodies. Human embodiment today comes in the form of hybrid human–machine bodies. It is the outcome of a joint process of becoming, where humans and machines evolve and mutate mutually.

Machine technology today (often literally) opens up the human body to enable drastic changes, changes that affect both its form and its cultural meaning. Because of the advance in transplants, genomics, prosthetics and the like, human bodies that change form and capacities are everywhere before our eyes, in the newspapers, on television and in everyone’s neighbourhood. But human nature is not open ended because machine technology makes it so. The human body has always been open to changes; it was never an immutable object. If it wasn’t for the continual changes and reactions provoked by the relation with others and the environment the human body would be lifeless. The liveness of the human body depends on relational interactions with others, living and nonliving. From this point of

view, the integration of human and machine technologies is a constitutive part of human nature rather than a futuristic perspective of transcendence. Moreover, when we interact with technologies, we are not only forming our own individuality but we are paving the way for the future individuation of that technology as well. This means that human beings and the technologies they create develop their potential qualities iteratively by interacting with each other. In other words, through their interaction humans and machines share informational codes and thus extend each other's biological and technical capacities.

The interaction can be modelled in different ways along a continuum between the two opposites of control and configuration. However, to rely on strategies of control means to centre the discourse on a supposed antagonism between humans and machines. Such antagonism not only negatively emphasizes the differences between the two, it also posits a hierarchical understanding of the living and the nonliving, a view which fails to grasp the understanding that humans and machines equally contribute to the emergence of cultural models. This work has argued for an open-ended mode of interaction, a relational configuration of the human and the machine which takes place at a physical and physiological level and thus allows for visceral and risky experiences. This is not only an aesthetic standpoint, but a political one as well. It is a statement against the reductive notion of body instrumentality that the present advanced capitalism aims to instil into the cultural fibre of our society. A notion whereby the human body is a mere source of data used to build genomic databases, make computations, customize social network avatars and control conforming and superfluous wearable technologies in the uncanny privacy of our isolated individual space. A lifeless body enchanted with self-indulgent predictions, obsessive "notifications" and unasked for fitness advice brightly shining out of mini displays.

Drawing on a cross-disciplinary approach embracing theory, science and artistic practice, this work instead posited a standpoint whereby the human being is an entity that can be constructively assembled with computational, biological and sound technologies. In this view, the codependence of human and machine is emphasized as a positive potential for unconforming modalities of embodiment: modalities that when shared among individuals can make new cultural models arise.

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