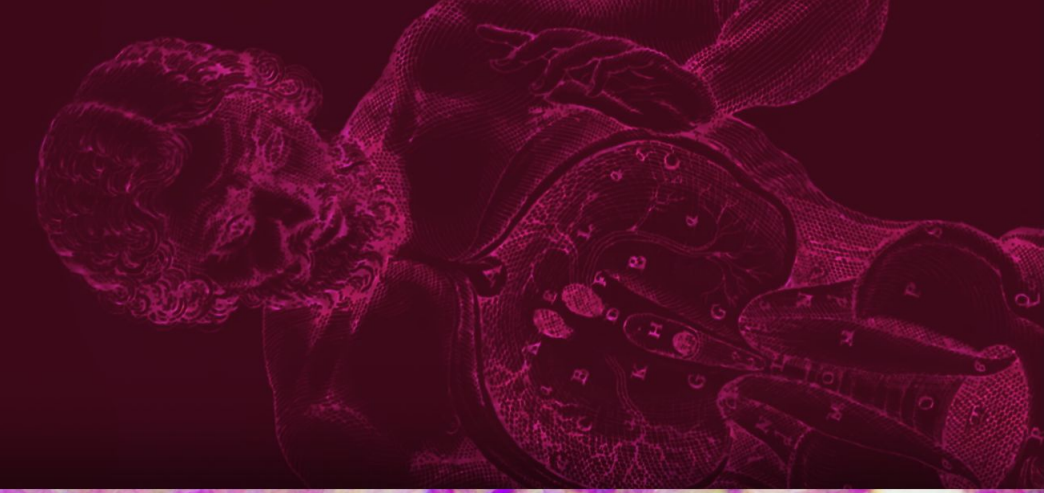
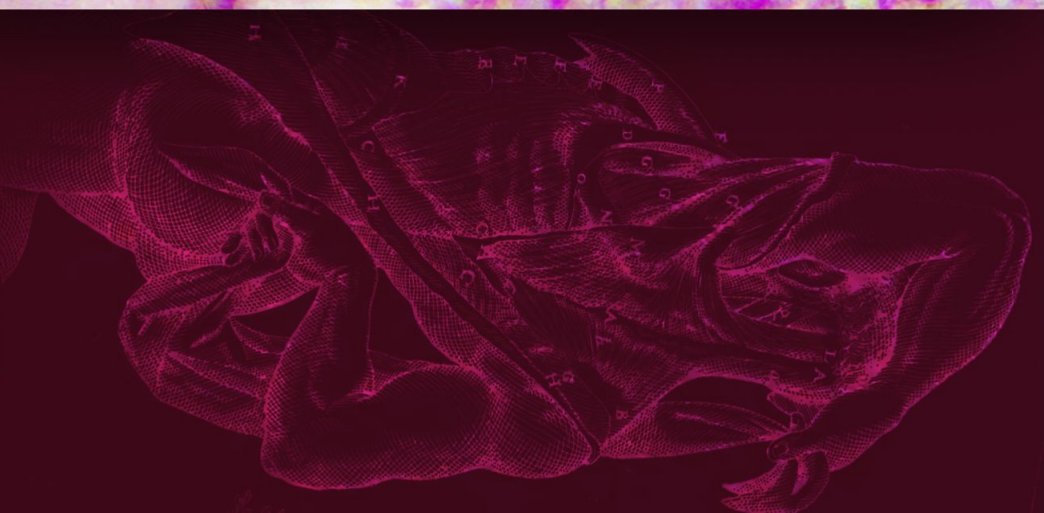


KEVIN BLACKISTONE

ACCEPTING THE BODY EXCEPTING THE FLESH

Metaphorical expansions of the unseen layers of the human organism and its technological relations



Universität für künstlerische und industrielle Gestaltung
Kunstuniversität Linz Institut für Medien
Interface Cultures

Accepting the Body
Excepting the Flesh

Metaphorical expansions of the unseen layers of the human organism and its technological relations

by Kevin Blackistone

Masterarbeit zur Erlangung des akademischen Grades
Master of Arts

Betreut von:
Univ. Prof. Dr. Laurent Mignonneau
Univ. Prof. Dr. Manuela Naveau
Prof. Dr. Hideaki Ogawa

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and of course to my family

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1 Artistic Background

My path to interactive media research, and specifically the kinds of work which are presented here, has been hardly linear, though in hind-sight a certain kind of cohesive. In my bachelors program my focus was originally 3d animation with interests to pursue either gaming or cinematic production. Through those interests and a desire to hopefully allow an end-to-end production capacity (as well as a favorable academic advisor in Bill Seaman, to allow certain credits) did eventually build the backbone that I use now in my interactive installation design. This melange ranged from computer science to electronic sound production and recording technologies. While the program at UMBC[1] had a strong experimental emphasis, my experiments then were primarily focused on building out my skill-set for this potential film or games work rather than any critical theory or installation arts.

The intervening years from then and my enrollment in Interface Cultures did not see me particularly pursue those original career choices, but the prior building of the multidisciplinary toolkit certainly shaped the path that eventually led to the realm of [frequently research-based] interactive installation work as the path moved from 3d & sound → web design → photo → video → projec-

1 University of Maryland, Baltimore County, Bachelors in Intermedia and Digital Art

tion → interactive → interactive installation – each layer frequently overlapping / incorporating elements of the prior. In the first decade of this time, I was primarily concerned with photography and video – usually semi-experimental rhythm-based music videos for songs I was writing or, more typically, hastily made shorts for local 48hour film festivals and the like. While my interest in data use for artistic source material can be seen in *Weather-Letters*, a video edited fully of GOES weather satellite imagery, it was far from a consistent occurrence at this time.

Around 2006, the Baltimore DIY arts & music scene started to become more alive in a multidisciplinary sense, with an outpouring in music, dance, theater and galleries spaces. I became active in many of these through acting, dancing, designing, performing, or any means of involvement I could find – as they similarly cross-pollinated. At the same time, I began exploring concepts of generative / interactive video and began using some levels of these skills in theater-based projection and lighting design. These collaborations continued until shortly before my exit from Baltimore.

During the concurrent years of 2011-2013 I found myself, through some happenstance and some intent, using what remained of my computer science skills in a fellowship position as part of a bioinformatics lab researching behavioral genomics[2]. My primary, semi-defined tasks were

2 National Institute of Health / National Institute of Alcohol Abuse and Alcoholism / Laboratory of Neurogenetics / Section on Comparative Behavioral Genomics

building ("mapping") genetic sequences, and analyzing their quality. While the research of my PI [primary investigator] and her lab focused on the behavioral genomics of primates, they were often unable to attend to the lab physically the majority of my time there. The results of this were two-fold: 1) I was generally a bit lost, having very little background knowledge in genetics, genomics, or the underpinning biology and 2) I ended up being a bio-informatics fill-in for projects in different sections of the same lab that the chief informaticist did not have time for (or assigned me in order to aid my growth as a researcher). By the time I was leaving, I had acquired a strong working knowledge in the field, having investigated topics including wild vs domestic cat genomics[3], de-novo[4] assembly of a glowing starfish genome (brittle star), gene pathways of Pre-Menstrual Dysphoric Disorder (PMDD), choline's role in reversing patterns associated with esophageal cancer, and methylation patterns in fetal alcohol syndrome. While my time in this lab was stimulating, it was lacking on the creative front as most of the visual graphic output existed purely on a functional level. I did start learning PureData at that time to

3 *Comparative analysis of the domestic cat genome reveals genetic signatures underlying feline biology and domestication*. Proc Natl Acad Sci USA. 2014 Dec 2;111(48):17230-5. doi: 10.1073/pnas.1410083111.
Annotated features of domestic cat - Felis catus genome. Gigascience. 2014 Aug 5;3:13. doi: 10.1186/2047-217X-3-13.

4 Typically a genetic sequence is constructed through comparison with a high quality, existing *reference genome. A de novo* is built from the sequencer data without this reference to compare to.

explore sonifying the genomic methylation of primates, with a hope of some utility or at least something acoustically interesting, but the result was less than stellar on both counts.[5]

Towards the mid 2010's I started working on doing my own productions of media artworks outside of the needs of various performance productions. This was aided by the expansion of certain funding sources and festivals in the Baltimore area. Looking back through some of the productions a certain thread can be seen as to the exploration of the human and it's placement of the self within space. *Digital Cascade* (2015) explored the voyeurship of the digital world and it's invasion into the privacy of thought, *Who's Watching* (2016) continued in the psychology of surveillance subject and voyeur, *Extensions of the Self* (2020) investigated cross-existence of participants in each others' bodies. While, ostensibly, *Radiant Flux* (2018) address astronomical research, it's hard to not see a piece comprised of mirrors as selfie-bait. In these, however, the focus was always visual.

5 Coverage as AM Modulation : 3k base pair segment per sample carrier tones (harmonic) amplitude boosted based on per base coverage, available at https://blackistone.com/Audio/AM.mp3 (Jan 2023)


WHO'S WATCHING (2017-2020)


DIGITAL CASCADE (2020)


EXTENSIONS OF THE SELF (2020)


RADIANT FLUX (2018)

Introduction to Presented Works

In what follows, I explore two layers of the human form that are often overlooked. These are the unseen bacterial symbiotes commonly known as the microbiome, and the interior organs which are fundamental to our existence. In this examination I seek to look past the common gaze-based view of organism as merely the visual layer with it's topological and aesthetic qualities. In this way, the works present a form of abstracted selfie, while they still have a focus on the body, it is not the one to which we are accustomed.

The first work will consider the microorganisms living and dying upon the skin. This unseen layer is no less a part of our bodies than those formed through mendelian (inherited) genetics, but are considered the other. They are also our first interface with the biological world outside of ourselves and help blur that implied delineation. This takes place through a metaphor exploring their colonization of what we view as the human body and incorporating that with our colonization of the planet, our technological hegemony thereupon and resultant depletions of resources and biodiversity.

In the second, I will be drawing focus to the interior. The organs that compose our selves are often neglected outside of personal health. Moreover, they are almost never considered when thinking about others. This seeks to present the in-

ner body absent the concerns of pathology, while celebrating the inherent similarities that make us human.

Rather than explore the works together with their influences, I intend to explore each individually as a layer of self-representation (with a brief moment to consider the central layer of the flesh) to be brought into collective focus in the final discussion. These layers shall be as follows:

Layer 1. The microbiotic self as the outermost level of interaction with the technosphere: - Artwork: *Microbiospheric Engineering*

> *The bacterial colonies of the microbiome used to colonize a micro-world as an exploration of that which makes us and a metaphor for our existence and technologically growing influence on the world.*

Layer 2. A brief moment in consideration of the flesh – Artwork: *A Thousand Hungry Eyes*

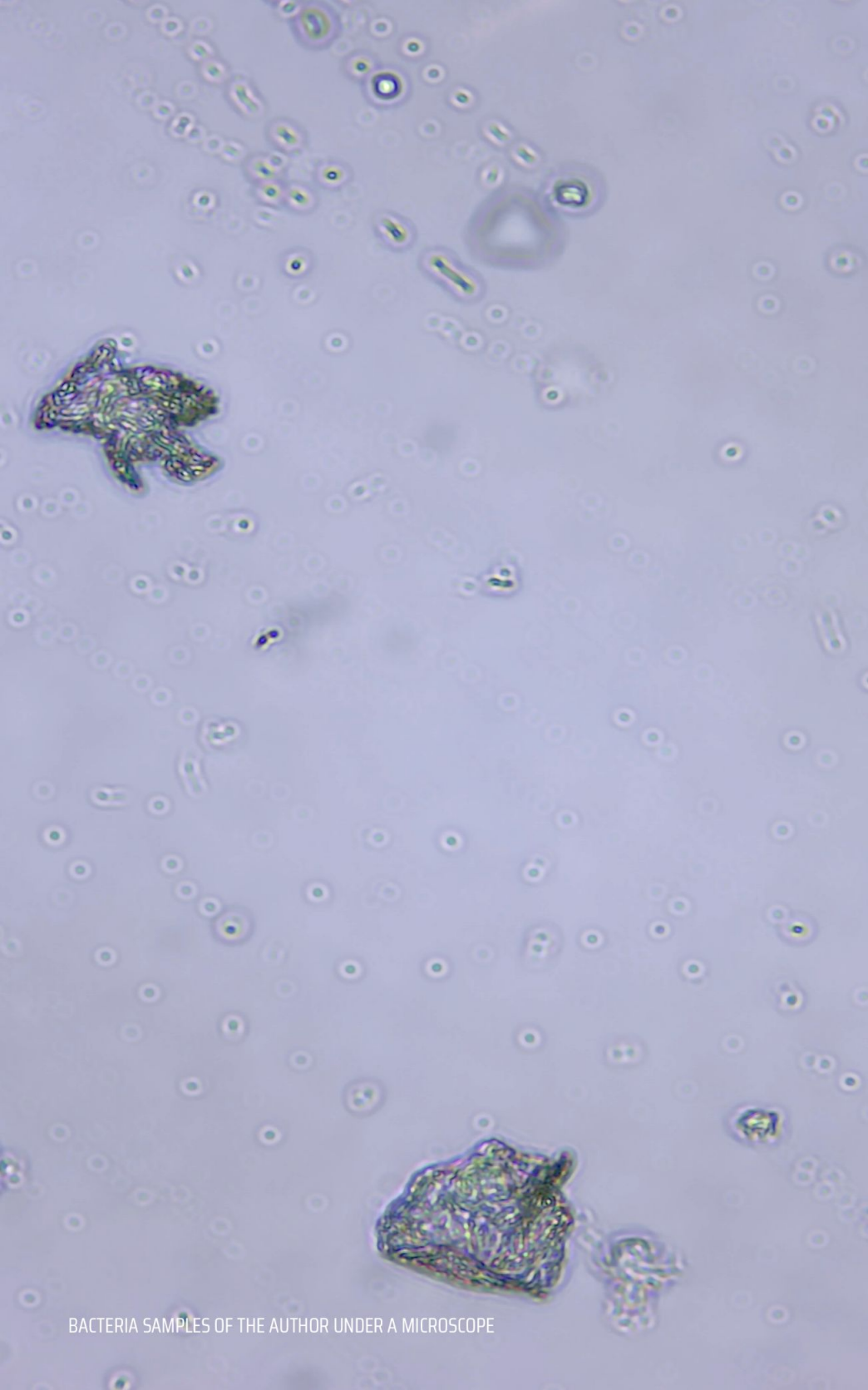
> *Visual human sexuality as a driving force in the development of technology. A momentary focus to contrast with the primary drivers of this thesis.*

Layer 3. The human organism in the absence of flesh – Artwork: *Exquisite Corpus*

> *Exploring the human similarities inherent when we ignore the surface layer of the visual self & the technological components which allow it's exploration.*

8

9



BACTERIA SAMPLES OF THE AUTHOR UNDER A MICROSCOPE

1. The Microbial Self

those which colonize us are a part of us.
as we are a part our inhabited world.

`Microbiospheric Engineering`

Abstract:

Microbiology invokes features of our environment that are often unseen - interacting without our direct intent or involvement, while automation conjures views of large-scale, tightly controlled mass-production. As our technology has progressed, our abilities to manufacture have extended into the micro world, aided by ever more refined industrial machinery. At the same time, these technologies have allowed us to further populate our own world while extracting from it ever greater resources.

Microbiospheric Engineering explores this convergence through a merged visual metaphor, involving human bacterial colonies, their interactions amongst wild-spawning micro-flora[6], and the automated systems that are used for their surveillance. These concepts manifest through a clear sphere layered with sculpted microbial

6 Microflora as the name given to the collective of bacteria and micro-organisms is being phased out in the world of microbiology as a misnomic archaiscism in the field of microbiology as flora represents the plants kingdom. It is still sufficiently commonly used casually, however, and is used here as the more poetic, rather than technically accurate term.

growth media. Bacterial populations are seeded by personal sampling of select of areas of the skin, monitored by robotically automated microscope and presented as visual landscapes and satellite-style vistas of their expansion upon the sculpted landscape. Each day, further growth appears upon the mountains, valleys and planes of this agar topography. An interior 360˚ camera provides a periodically updating global world-view, while building a time-lapse of the colonial expansions.

These combined built and spontaneous cartographies provide means to internalize population expansions and resource depletions of our own biosphere, while the proximal automata presenting these unseen worlds draws focus on the approaching micro : macro interactions of mechanical : biological manufacture and our own potential technological limits of growth.

Introduction

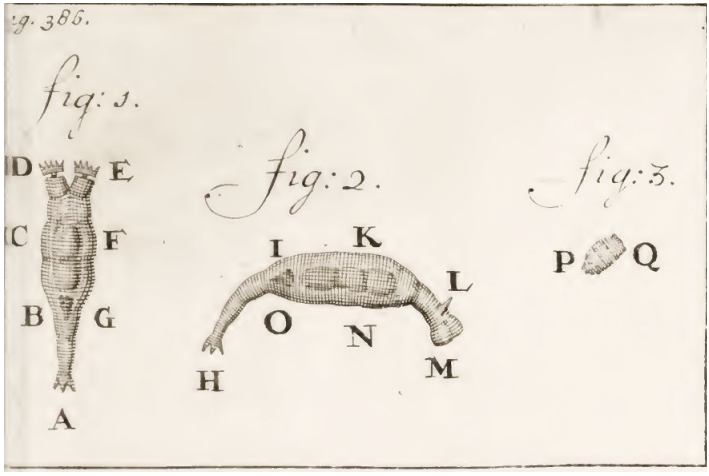
As alluded above, this work explores the surface layer of the human microbiome through a full extraction from it's host body. By cellular numbers alone, these organisms have been found equivalent to the cells of our own bodies (~39 trillion)[7]. Further, numerous health traits have been linked to this colonial population – both beneficial and pathological. While much of this is internal (ie. to our digestive system) the populations upon our skin play a significant role as our outermost layer and first interface to the world at large.

Similarly, our species operates as a part of the surface biome of the planet we inhabit. Just as our bacteria are individually the smallest actors in the world of the individual, we are individually small actors on the planetary surface. It is in our collective actions that this metaphor becomes divergent. While our bacterial layer exists primarily in a state of relative equilibrium, our collective impulse is to grow continuously. We construct massive machinery capable of delving into the global surface, extracting it's resource wealth and using that to construct our architectures and devices – to the detriment of our planetary cohabitators in the flora and fauna residing in any area of exploration, resi-

7 While it has been frequently repeated that the microbiome outnumbers our own cells 10:1 due to research from the 1970s, this number has been since updated. see: *Revised estimates for the number of human and bacteria cells in the body*; Ron Sender, Shai Fuchs, Ron Milo; bioRxiv 036103; doi: https://doi.org/10.1101/036103

dence or disposal. Left unchecked, we may prove to be more a parasitic growth, than a mutual benefactor with our host. Yet it is also in this growth of technology that we have had the capacity to become aware both of the our invisible cohabitants and of our large-scale impacts.

This work look at these concerns through an inversion of this scale. Our microbiota become the colonizers of a world smaller than ourselves. The industrial machinery (in this case robotics), are presented as *greater than* and *outside of* that world rather than an individually micro *part of* it. The video feeds then present the growth through another inversion of scale, as the microscopy expands the landscapes to terrestrial familiarity.



Antoni van Leeuwenhoek, c. 1675

Background

> With electron microscopes we can now see molecules and viruses, and what formerly were hypothetical entities and place-holders in theories are now as ordinary as mailboxes. It is true that the introduction of new optical instruments has historically been attended by skepticism about whether what was seen was merely a visual artifact, but, as the history of the microscope shows us, it was hardly the final and most-considered reaction (Goldberg, 2001, pp. 65)

A Brief Introduction to Microbiota

Microbiota are the miniature organisms inhabiting all multicellular beings. These can include not only bacteria, but life from other domains: fungi, viruses, archaea and protists. Although the concept of microbiological life can be found in sources as far back as 6th C. BCE Jainist scriptures and was theorized medically by works such as *The Canon of Medicine* (11th C. CE), by the Persian polymath Ibn Sina[8], their visual discovery through microscopy is generally credited to Antony van Leeuwenhoek (1632, Delft Dutch Republic) in the eighteenth century through his pioneering work observing the structural details of cellular organ-

8 Microbiology. (2022, Dec 15), In Wikipedia. https://en.wikipedia.org/wiki/Microbiology

isms. Early findings showed that a number of these were responsible for disease, thus starting off what is now known as the *germ theory of disease.* Through the past century, however, it has been demonstrated that only a very small percentage are associated with any known pathogenicity. Rather, the vast majority exist in a stasis of symbiosis – in which both organisms benefit by their shared existence. or it's subset of commensalism – in which one organism benefits while the other is unaffected.

The study of the microbiome has always been a multidisciplinary approach, drawing from studies in several fields including agriculture, food science, biotechnology, and medicine – all while extending their individual reaches.[9] The elements of co-evolutionary existences have lead to growing paradigm shift to a holistic understanding of the body as a meta-organism. This includes ideas and research demonstrating that, while only a minuscule number of micro-organisms are pathogenic, a diversity loss at the microbiome level, or 'dysbiosis', may cause cascading impacts on host immune systems. It is thus again that this avenue of research overlaps with concerns of the larger biosphere, both in our co-evolutionary existences as well as our present human-driven collapses in global diversity.

9 Berg, G., Rybakova, D., Fischer, D., Cernava, T., Vergès, M.-C. C., Charles, T., … Schloter, M. (2020). *Microbiome definition re-visited: old concepts and new challenges. Microbiome*, 8(1). doi:10.1186/s40168-020-00875-0

Bacterial Art

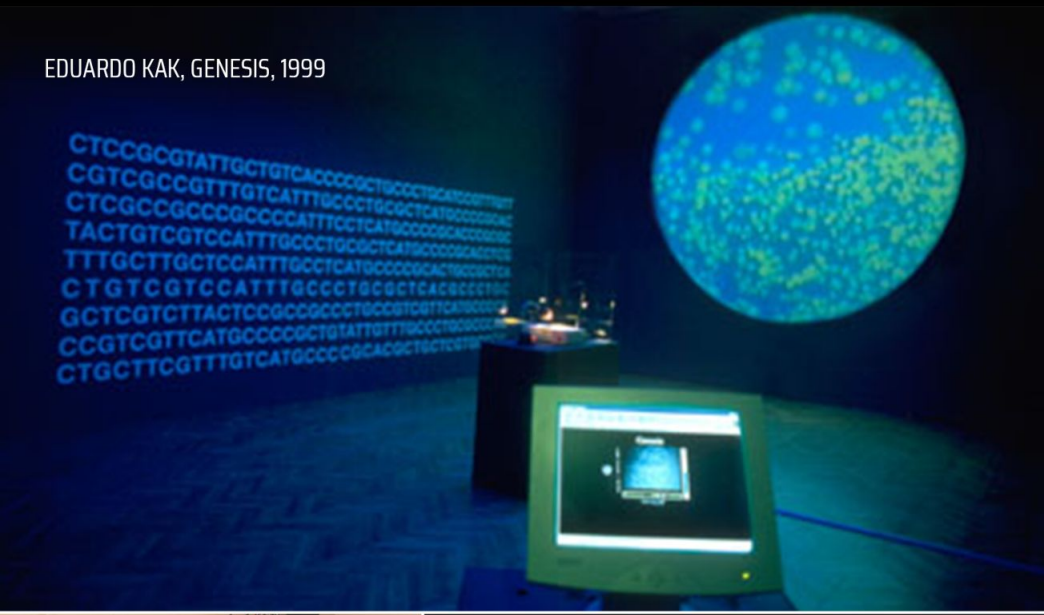
The highly visual nature of microscopy in general, and of bacterial study in particular, lends itself well to artistic-scientific mergers. That much modern microbiology involves the use of what could be considered artistic mediums and practices such as colored dyes and starkly lit photography could be seen as making such overlaps inevitable, including scenes in Salvador Dalí's film *Impressions of Upper Mongolia* (1975). In the media arts sphere, Eduardo Kak's *Genesis* (1998/99) projected bacterial growths under a microscope highlighted with ultraviolet light and controlled remotely by participants, which would then manipulate the growth of the bacteria with the thus-highlighted microbes providing a provocative visual display. In the name we see another instance of the idea of populating a new world. In fact, it was:

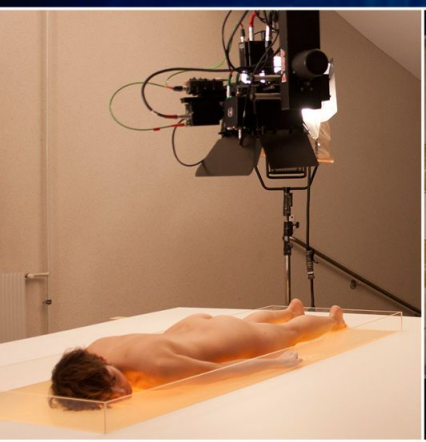
> **... chosen for what it implies about the dubious notion--divinely sanctioned--of humanity's supremacy over nature. (Kak, 2001)**[10]

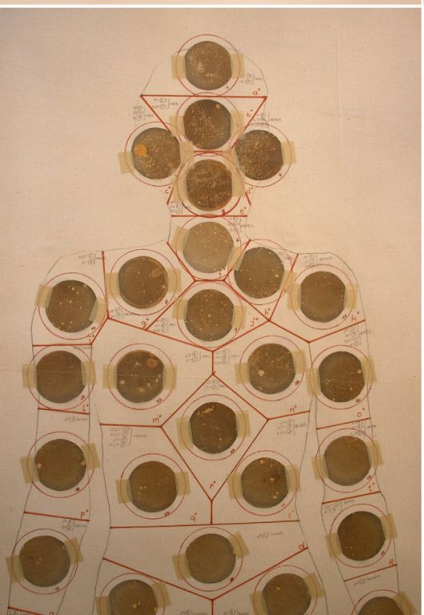
While I don't speak to any notion of the divinely sanctioned, the relation of anthropocentricity over nature is certainly relevant.

10 Retrieved from: https://www.ekac.org/geninfo.html

EDUARDO KAK, GENESIS, 1999







SONJA BAUMEL - ABOVE: EXPANDED SELF, 2012
BELOW: CARTOGRAPHY OF THE HUMAN BODY, 2011

More recent and specific to explorations of the human microbiome are the works of Sonja Bäumel. *Expanded Self* (2012, in collaboration with Erich Schopf) specifically uses the body to leave the bacterial imprint resulting from the process of laying across a large container of agar growth medium. This work provides, through visual means an extricated population of human bacteria, however in this case, the goal is a frozen snapshot of the growth once it has reached a visually compelling population, rather than highlighting variations in growth over time. As such, the results leave a visual print not far from that of any medium coating a living body pressed to canvas. More connected to the research and geological metaphor of *Microbiospheric Engineering* would be her prior work (also in collaboration with Erich Schopf), *Cartography of the Human Body* (2011). This project involved the cultivation and study of skin bacteria over an eight month period, then selected to achieve desired colours, and reapplied to the body to use as the bacterial layer for the agar imprint. One can see the array of bacterial appearances in the image of petri dishes mapped to the body regions, although this mapping was from the study period. While the reapplication to respective body parts to produce the imagery once again relegated these lifeforms somewhat to the status of a slow developing pigment in the final form, they still have the effect of demonstrating the diversity of our microbial cohabitants.

20 Planetary Research, Microbiology and Art

The metaphor of planetary colonial expansion through microbiotic self-colonization has a somewhat surprising overlap with many of the ideas demonstrated through research into *trans*planetary research (in which colonization of other worlds is considered). In the first capacity it is the research of extremophiles[11] that has spurred the realization that in the seeking extraterrestrial intelligences, any such organisms may not follow our presumed requirements for life. In the second capacity, it is that life on our own planet may well have been fed through extra-terrestrial influence. Specifically, *"...microbial descendants of some of these proto-organisms may still be with us on Earth today."**

> ...it is time to weaken the paradigm in modern biology which maintains that all life on earth shares basic molecular and biochemical features. The place to look for life with different biochemistries is among microbial communities, they claim that we cannot exclude the possibility of a shadow biosphere actually existing here and now.
> (Kluszczynski, 2012, pp. 64)

The blend of the microbiome with its host species is known as the metabiome. Engaging with the organism as it's collective rather than singular meta-self expands the paths that might be

11 *Extremophiles* - organisms which can live in environments commonly believed too extreme or hazardous to support life.

taken to advance as a species (or perhaps, metaspecies). In the consideration of interplanetary expansion we again see the need to understand this layer of our selves holistically. Craig Venter, founder of the *Human Genome Project* stated that the we must *"enter the genomics era to have any hope of success with human space travel"*. While this sentiment of personal genomics is expected, what has been less considered is his further statement on the potential of genomics of this metabiome – specifically as regards our future capacity for interplanetary exploration.[12]

> Knowing already that nonhuman microorganisms outnumber our own cells, we are only just starting to understand the extent of the impact the organisms have on our physiology. Venter's plan [is] to design humans works via the microbial life of our bodies for which he proposes to "develop a metabiome cocktail with desired traits to replace the preexisting ones"
> (Kluszczynski, pp. 76)

To strangely loop back from this metabiomic view of the cellular world to attempts to colonize and grow our own living tissue – research using human tissue have produced new cell lines that may even be viewed as a distinct species. The first human cell lines were cultured in 1951 from the cervical cancer of an African American woman Henrietta Lacks (without her knowledge or con-

12 Craig Venter speaking on synthetic biology at NASA at Ames. 27 Oct. 2010, Accessed, Jan 2023 http://www.youtube.com/watch!v=KTzG_HIUu9c

sent). These thus-named HeLa cells proved to be an immortal cell line, but not without intergenerational mutation.

> HeLa cells might constitute a new life form. HeLa cells are the best-known cultured cells of human origin...they have become a separate species restricted to a particular environment". In other words an "odd" life form in a laboratory environment. (Kluszczynski, pp. 143)

Here we have a colony of cells, originally a hostile form (*cancerous*) from a human's body. Through their colonization outside the host environment, they may no longer be considered human cells. That these cells are used in a wide array of research in genetics and medical testing of the human body demonstrates we have even found was to produce a synthetic channel of influence as a once human, but now multi-colonial cellular lifeforms having a significant influence on our lives. To return the prior topic, this has been considered in the art world, as *"Catts and Zurr's semi-living sculptures grow as a result of and seemingly in response to their concept of the Extended Body. This category, also referred to as biomass by the artists, includes the living cells and tissues scattered across research laboratories and medical institutions, isolated and separated from their parent organisms." (Kluszczynski, pp. 78)*

The production of synthetic life brings forth another direction in which the elements of this metaphor are converging. While the primary technological element here is presented as the overscaled robotics encircling the miniature world, ad-

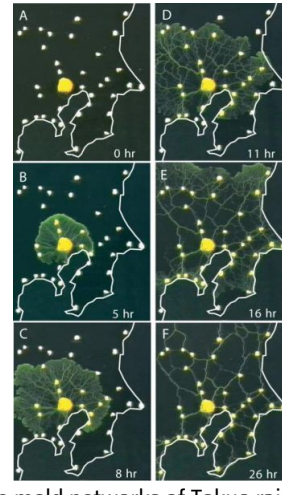
vancements have not been limited to simply the most clearly visible mechanical tools of resource extraction and use. It has provided research that puts us now on the cusp of many bio-inspired and bio-produced material manufactures.

> A future dominated by a single engineering paradigm might be upon us; bio-matter is increasingly used as raw material. If this is the case, the engineering approach should not be allowed to monopolize life.

...which is why..

> One way to emphasis and attract attention to alternative frames of though is to open up the very same tools and spaces that serve this future to others, including artists. (Kluszczynski , *pp. 151)*

Interestingly, microcellular life has already demonstrated capacities thought existent only in the domains of more 'advanced' life. They can colonize into organized networks not dissimilar from our own. One slime mold has shown it's capacity to model the Tokyo subway given only nutrient sources scattered to approximate the locations of Tokyo's cities – naturally reconstructing a network echoing that developed by engineers[13].



Slime mold networks of Tokyo rail system

13 * Tero, A., Takagi, S., Saigusa, T., Ito, K., Bebber, D. P., Fricker, M. D., ... Nakagaki, T. (2010). Rules for Biologically Inspired Adaptive Network Design. Science, 327(5964),

Bacterial capacities further include extraction and use of resources to build electrical prosthetic appendages[14] (one of multiple instances of bacterial nanowire fabrication). Even so, these adaptations and demonstrations are still that of organisms existing in isolation, and their research is merely demonstrative of individual means of survival, but not in relation to any other organisms. *Microbiospheric Engineering* explores the commensal relation of our microbiota to demonstrate against our own exploitative existence through expansive technological growth (as extradited to an inhabitation with limited resources). If one is to argue the growth of nanowire prosthetics by bacteria constitutes a technological growth, it remains one which does not provide a disproportionate advantage or allow massive exploitation of its environment in the ways permitted by our own.

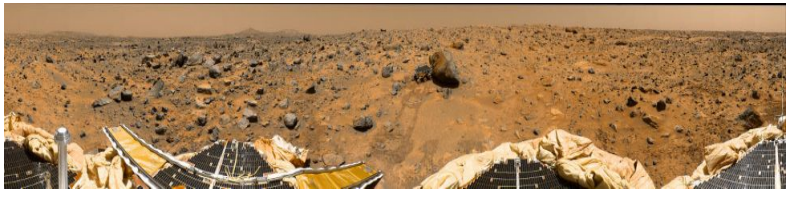
Telematics & Telerobotics

Microbiospheric Engineering very much echos the original scientific uses of telematic microscopy and telescopy. Some of the most dramatic and well-known use of this imagery has been the monitoring of the planetary. Geostationary satellites since GOES-8, operated by the *National Oceanic and Atmospheric Administration* (US), have

439–442. doi:10.1126/science.1177894

14 ** Gorby, Y. A., Yanina, S., McLean, J. S., Rosso, K. M., Moyles, D., Dohnalkova, A., … Fredrickson, J. K. (2006). *Electrically conductive bacterial nanowires produced by Shewanella oneidensis strain MR-1 and other microorganisms*. Proceedings of the National Academy of Sciences, 103(30), 11358–11363. doi:10.1073/pnas.0604517103

provided near-real-time satellite imagery of the earth and its weather systems. While terrestrial and orbital telescopes have permitted the visual exploration of the universal expanse. Not only in our world has telematics (and telerobotics) been a means of exploration – The Mars Rover in 1994 provided the people of earth the unprecedented opportunity to view the surface of another planet over 100 million miles away through the then still new World Wide Web.



Panorama of the Martian surface by the Mars Rover, 1995

Goldberg tells of the first webcamera set up in the early nineties to monitor a coffeepot (pp. 8), and how, in very little time the same team had expanded into telerobotics through a collaboration in which a, "digital camera and air jet were mounted on a robot arm so that anyone on the Internet could view and excavate for artifacts in a sandbox located in our laboratory" (University of Southern California, 1994)

> Webcameras enable us to select from hundreds of destinations, and observe these at any hour of the day or night. The power to do so represents a quantum expansion of our personal space-time envelope; [...] As byte-sized portals into far-off worlds, webcameras demonstrate effectively how technology is dwindling the one-time vastness of the earth.

> The story of technology is largely one of abnegating distance-- time is expressed in terms of space. (Goldberg, 2001, pp. 24)

This work plays with this abnegation of distance in it's planetary metaphor, but more-so abnegations of time and scale. It contracts the timeline of human population growth through the more rapid reproduction of the bacterial colonies while it expands the scale of their existence to replicate the familiarity of our own.

One can see the early exploration ideas of the temporality of biological growth via telepresence and telerobotics through the *TeleGarden* project directed by Ken Goldberg (1995). In this, online users could take care of a small garden using robotics to plant seeds and monitor their status. Beyond the entertaining and explorative aspects of the garden, the timeline on which biological growth occurs and the delay response inherent to the technology brought questions of belief into the mix. The absence of one's physical existence within a telepresent system requires a faith in accurate representation on the other end. While Machikko Kusahara suggests many traditional, personal gardens were once a private affair, affording a level of secrecy to the well-to-do, the modern has made them a primarily public affair. TeleGarden, *"brought back the thrill of secrecy to the garden. What is the feeling of owning a flower or a vegetable in a garden that one has never visited, and will never visit, yet taking care of it telerobotically and watching it grow? Only a limited number of people know about the garden and are allowed to (telerobotically) enter. Even though it is a "com-*

mon" among users who share the garden, it is still a secret garden. Like the stone garden of Ryoanji Temple[15], which visitors are not allowed to step into, the Telegarden is to be seen only from inside." (Goldberg, pp. 205) In *Microbiospheric Engineering* I try to reverse this idea. While there is still the requirement of trust – in the camera, in my bacterial sampling, in my sanitation procedures – the end goal is to make what is secret (or at any rate, unseen) and private (or rather, personal) into a very public and visual realm.

Technology has always been a driving force in the domain of the agricultural. It is widely believed that advancements allowing shifts from foraging to agricultural behavior were a significant factor in how humanity spread across the planet and established its settlements that became towns, cities and empires.[16] In more modern times, our technology has advanced to such a level that it can till vast acreages of farmland, or obliterate the ecosystem to extract minerals beneath. It is somewhat in the domain of the former, but primarily in the latter that the machine has come to be regarded as a scourge to that which is natural. The many back-to-nature movements that have presented themselves since the industrial revolution have traditionally relied upon a distal view of the use of any machinery in any such exodus. Tom Campenella writes:

15 Located in Kyoto, Japan

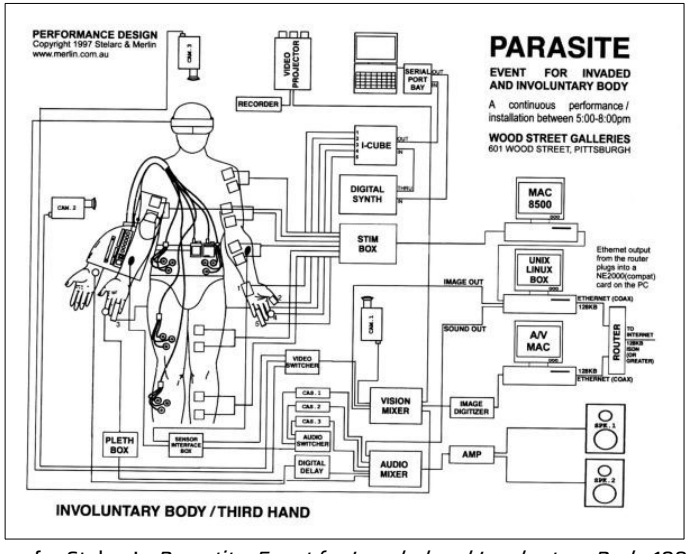
16 McNeill, W. H. (1984). *Human Migration in Historical Perspective.* Population and Development Review, 10(1), 1. doi:10.2307/1973159

> The machine, representing civilization and the city, appeared to fundamentally threaten the sanctity of the natural world [...] But the tension between machine and garden also yielded a great paradox: Technology was condemned on the one hand as spoiler of the garden, yet embraced on the other as the very means of getting "back to nature.""
> (Goldman pp. 36)

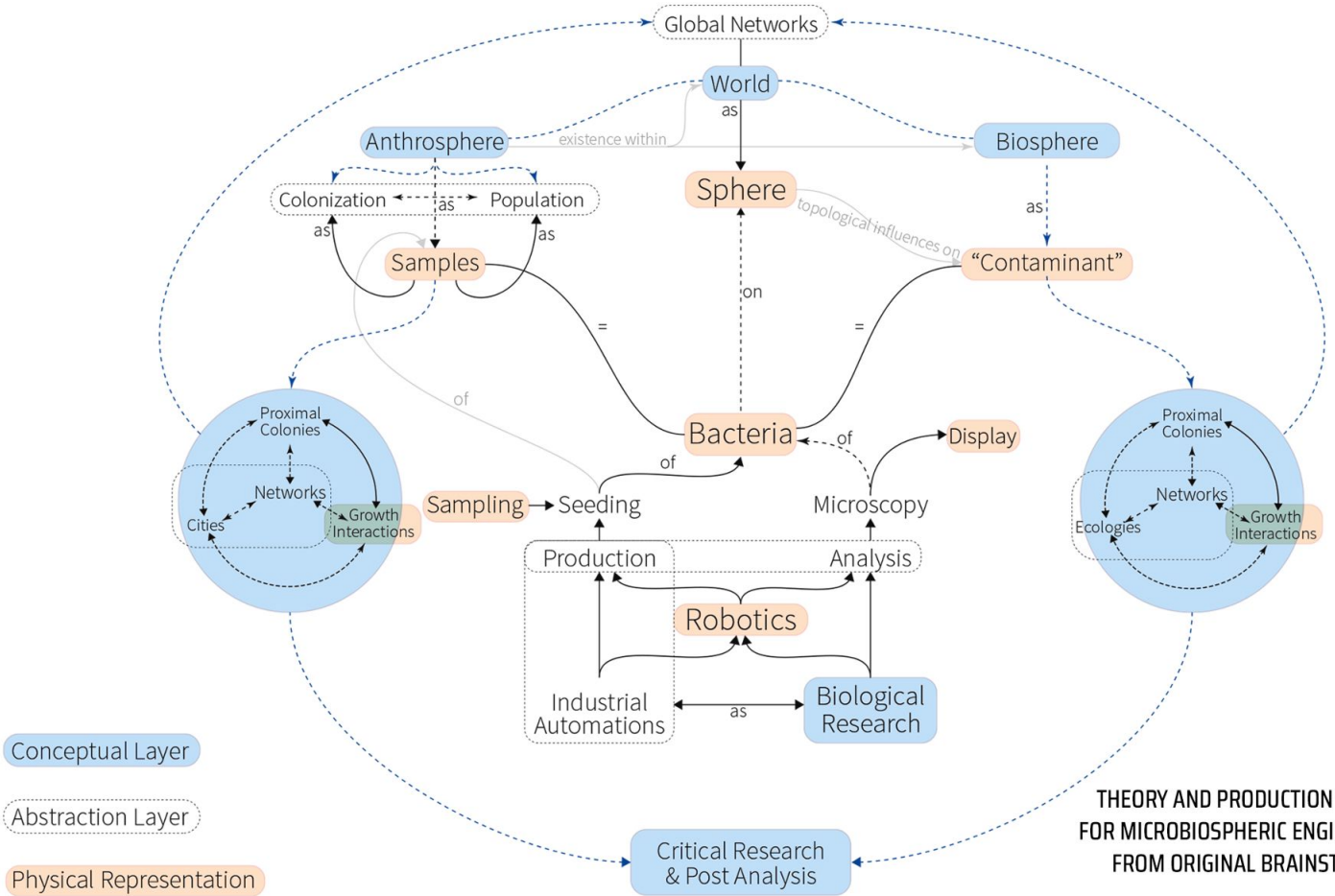
Through such creative uses of telerobotics as progenitor and caretaker of life, an avenue is given to bridge this otherwise binary perspective.

In many of the works by Stelarc, but primarily, by name at least, *Parasite: Event for Invaded and Involuntary Body (1997)* we find not only incorporation of robotics, but also of alienated and uncontrolled elements incorporated with the body. These parasitic prosthesis are not entirely dissimilar from the microbiome – they are not of the self, but become a part of the self nonetheless. Likewise is can be said that both can affect a control of the officially defined body beyond that granted through the central nervous system. Stelarc defined this as a *split physicality*. Here however, I present a physical split in separating the organically synergistic from it's host and providing it a new inanimate (and eventually uninhabitable) world – host in absentia.

Ken Goldberg, Telegarden, 1995



Flyer for Stelarc's *Parastite: Event for Invaded and Involuntary Body*, 1997



THEORY AND PRODUCTION SCHEMA
FOR MICROBIOSPHERIC ENGINEERING
FROM ORIGINAL BRAINSTORMING

Process

In considering the above concepts, I wanted to be able to populate a large sphere with the bacteria of multiple individuals, using robotics as the means to produce the colonization and as the means to monitor the growth. I intended that those who provided samples be able to return to check the progress of their personal colonies. For many reasons this changed over time to a much simpler form. Practically, the scale had to diminish, while the pandemic limited the ability to sample from a population beyond that of myself. This and following sections will explain further some of the original design strategies and inspirations, as well as their path toward the final form.

The technical design of this work was to use a participant controlled robot to both seed the bacterial colonies and to later monitor their temporal growth. On this level, it echos the 1995 prior mentioned work *Telegarden* and that work's design to allow participant planting, watering and monitoring of an area of growth through robotic arm (although much of the planned interactive elements were removed as discussed later). The difference is that *Telegarden* was discussing the state of its parts and visually showcasing telerobotics, (in addition to prior-discussed theories of trust) and while, certainly, that is an element in *Microbiospheric Engineering*, the design was to use these elements to explore the metaphor and demon-

strate the relations between our micro/macro worlds. It was also originally intended to be primarily controlled by local participants..

In a sense, the design was to visually merge the concepts of both the telepresent with that of virtual reality, however in a manner that presents a virtual space that exists in the physical world. First, it is virtual in that it is a model of a biosphere. Next, the transposition of scale from the micro growth upon the globe to the macro scale of the screen presents no less a virtual world than one that is rendered in computational space[17]. What's more, the footage from the interior camera can present it's own immersive environment from the model world. This merger of concepts forms a basis of a more transpositional reality that a virtual one and overlaps to a certain degree with the ideas of immersive cinema. Interestingly, to revisit and slightly expand the concepts of inhabiting extra-terrestrial spaces, when viewing the 360˚ camera in this way, the interior ↔ exterior of landscape become inverted, giving the perception of a Bernal Sphere[18], rather than a planet.

17 Although it may be considered any telepresent data has gone through a computational layer and is thus 'rendered', I do not mean to be that pedantic here.

18 *Dyson Spheres* are one of many designs proposed in the 1970s summer studies commissioned by NASA to investigate the possibilities of constructing space habitats. For more information see: Scharmen, Fred. *Space Settlements,* July 2019

Bio-testing

With the help of Anastasia Bragina at the Ars Electronica Biolab, I was able to experiment with colonization of personal samples and learn the protocols necessary for such. This began, as it must, with learning to produce the growth medium in a sterile setting – if I was to contaminate it with 'ambient sampling' I had to be clear that it was part of the intent and duration of the work and not simply an error of production and sloppy sanitation procedure.

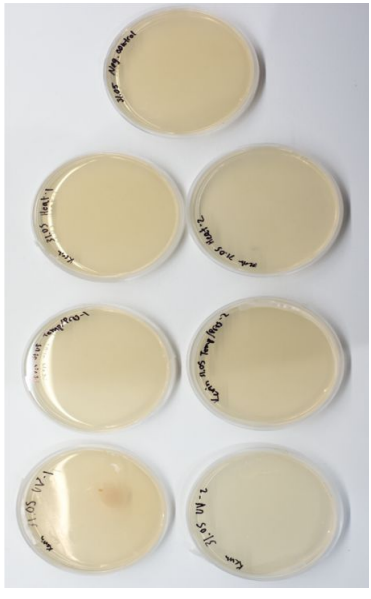
Simultaneously, I was developing my process for coating a glass sphere with the agar medium. To my knowledge there is no information on the use of agar to cover a non-horizontal surface and so I had to build up my process blind. This turned out to be a laborious procedure for a number of reasons:

- The solution is very hot when wet and does not readily stick
  to glass surfaces, leaving only a very thin coat.
- As it slowly cools it can start to stick to the thin prior layers, but once it gets to this point, it is also congealing in it's holding container and thus begins to become unpourable.
- With the lack of strong cohesion, the agar begins to slide and drip from the vertical and upside-down surfaces of the sphere.
- As the lower points lose there coating, the upper parts begin break apart and to slide down as well.

- As the agar cools, it sweats. This can cause a layer of fluid to form between the congealed medium and the glass surface, exacerbating the issues.

The developed process was thus:

- Pour the hot agar first, building a very thin layer.
- As this layer cools faster than the fluid in the container, more layers may slowly be built up.
- As the agar still not applied begins to congeal, it can start being applied with a utensil or by hand to build the geographic features.
- These can be pushed around, cut up, and otherwise sculpted on the sphere.
- As pieces slide of of the bottom, they are collect them to rebuild at the top until everything has settled enough to cease movement.



Sanitation testing at the AEC biolab

TOP: THE SPHERE AS PREPARED FOR WORLD MICROBIOME DAY INSTALLATION.
BOTTOM: DETAIL CLOSE-UP OF GROWTHS ON DAY 3.

36 Early Testing with Participation: Microbiospheric Globe

As an early test of seeding and growth I was invited to participate in *World Microbiome Day* with one of the tougher audiences … children. This provided a chance to learn if the agar sphere would hold up after several hours of physical interaction. For this revision, no robotics were used. Sampling was provided by direct contact of individuals with the sphere itself. With the fresh agar, the contamination and safety concerns were not greater than if the children were to shake hands with each other, however this was still enough cause to provide hand sanitizer to each participant after exposure. After the event, the sphere was placed in a sealed container. Three days later it was removed and the results documented.[19]

With the favorable results from the first experiment, and a recent acceptance to show at *Siggraph Asia 2021* I began working on the inclusion of robotics. I enlisted Amir Bastani of the *Creative Robotics* research unit of *Kunstuniversität Linz*, (Linz, Austria) to aid in the production as he had experience in both coding an arm to move around an object and to do so with an attached microscope. Over the course of production, many elements continued to change due to practicality and pandemic concerns. The project, originally in-

19 It was then resealed for another month as a secondary experiment at the end of which all growth had died from dehydration

tended to show in Tokyo, had to be produced in Linz's *Grand Garage* and live-streamed to the festival. Due to contamination protocols, both regarding corona and from bacterial growth, of the venue, several reconfigurations of the idea took place. Primarily, I would not be able to have participants provide their personal colonies. I resolved instead to reconfigure the metaphor, where the spatial elements of the seeded growths would not be a map of inter-human regionality, but an exploration of remapped topology of one individual's skin to the surface of a sphere. In this way, it became a form of abstracted self image which still maintained the premise of both colonial growth paired with the industrial expanse

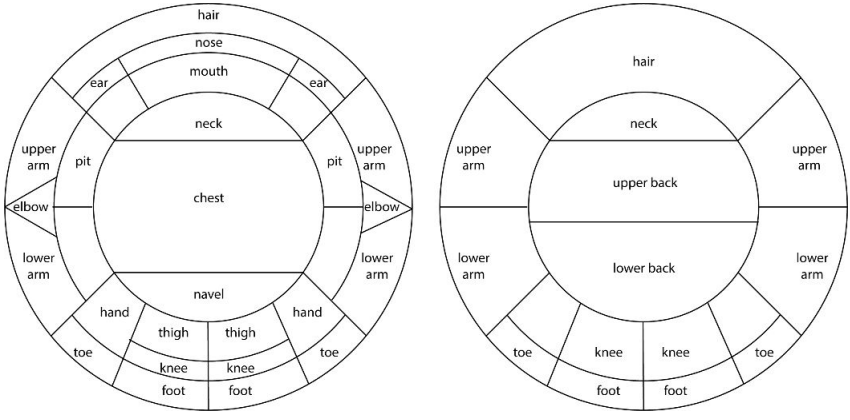
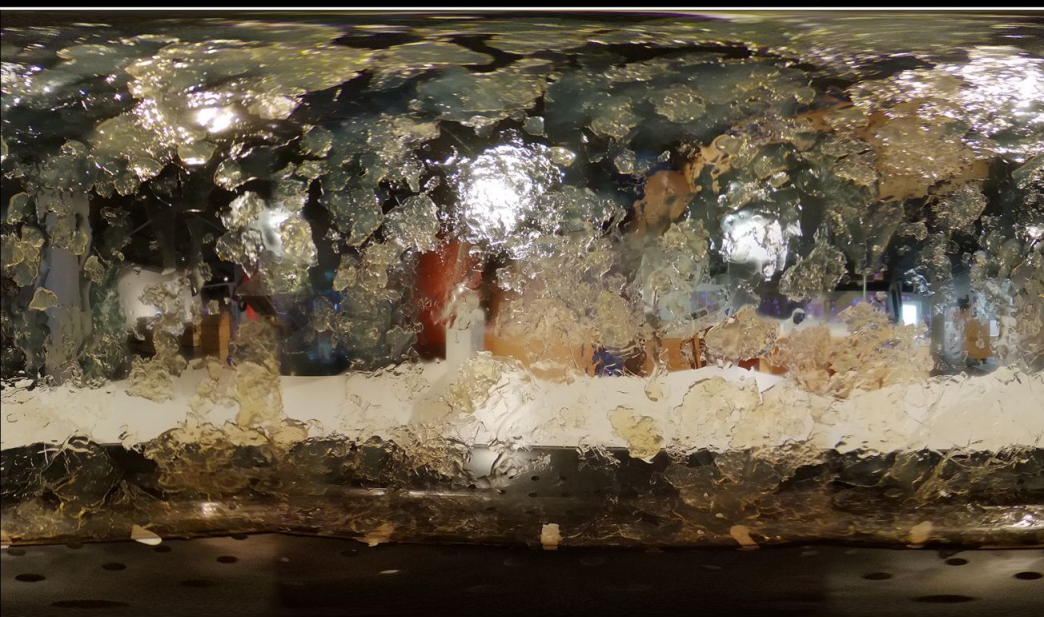


Diagram of intended mapping of bodily regions to spherical topology

INTERIOR VIEWS OF THE GLOBE
ABOVE: 'TINY WOLD' PROJECTION FROM MICROBIOSPHERIC ENGINEERING [DAY 4]
BELOW: EQUIRECTANGULAR PROJECTION FROM MICROBIOSPHERIC GLOBE [DAY 0]



Technical Implementation

The resultant installation of *Microbiospheric Engineering* came together as follows: Individual samples of bacteria from an array of bodily regions were collected by swab the morning of the production and stored in saline solution within labelled spray vials. A ~30cm glass sphere was coated in agar and placed on a small stand. Inside the sphere a 360˚ camera was set up to take an image every two minutes. The robotic arm was calibrated to focus a microscope to the surface of agar coating as it moved around the volume. A pre-programmed path of interesting features was chosen in lieu of interactive control due to the remote viewing nature of the final form. The whole installation was covered in a clear container to limit outside air exposure during the growth period and to maintain the humidity of the environment to minimize dehydration of the agar. Each sample was sprayed onto the sphere in it's designated region using a small entry slit in the back to minimize aerosolized particles from contaminating the outside air. Outside, a webcam was arranged to monitor the complete setup. A local computer downloaded and remapping the 360˚ camera frames and publicly streaming them with the other feeds for the duration of Siggraph Asia's *Art Gallery* in Tokyo (> 4 days) and kept live for the duration of the final sanitation procedure.

TOP: FINAL INSTALLATION SETPPU AT GRAND GARAGE FOR SIGGRAPH ASIA 2021 [DAY 4]
BOTTOM: BACTERIAL COLLECTION VIALS IN THEIR DISPLAY WITH SAMPLE LOCALIZATION DETAILS

Results

The setup and streaming of the project were quite successful. Unfortunately, without the ability to be present at Siggraph, I was unable to collect observe the majority of viewers or gain feedback from them, but the response from the few available visitors to the physical exhibit and the several individuals who participated locally as online viewers spoke well of it's general implementation. While I did not record specific responses, elements from these as well as my own, primarily production-related, lessons are presented next.

Lessons

While the final production was far from perfect in it's design, the elements held up through both (limited) live viewing and the online stream. Several difficulties did arise, however, and much was learned in the process.

Agar and Vertical Surfaces

Agar does not like vertical surfaces. As it cools it sweats not only externally, but also forming a layer of condensation between itself and the glass. This might not be the case for all materials due to the ability of glass to transmit temperature from one between sides, but it was my experience here. This became particularly frustrating when, having near completed the sphere for presenta-

tion, the entire coating slid off and I needed to hastily reapply in a manner not as appealing or sculpted as the original.

Sanitation and Bureaucracy

In this work's development, I was the latest amongst a long line of bio-artists to discover the bureaucratic headaches that arise from concerns over sanitation, safety and ethics resultant from growing anything beyond plant life. In their production and presentation of 'Semi-Living' artworks in Australia, Catts and Zurr found themselves in an *"atmosphere marked by fear"* requiring an *"insurance policy"* based on three conditions.[20] This bore out in that I needed to not only provide a lengthy, detailed protocols and explanations manual for every aspect of the process to install, but that several elements of the required process were inhibitory to producing the work as desired. Most specifically, actually spraying the sample to the defined regions was near impossible with the designed containment, and much of body regions as mapped to the globe were thus not highly specific.

20 "the organization of the exhibition took place in a tense atmosphere marked by fears on the part of Australia's conservative government about the consequences of the gallery exhibiting a semi-living sculpture of a human ear. In order to provide itself with an "insurance policy", the gallery conditioned its decision to present the artists' work on their fulfilling three condition." (Kluszczynski, pp. 35)

STILL FRAME FROM THE LIVESTREAM, DAY 2

Dehydration

While there were no problems with dehydration in any of the tests, those took place in smaller containers. Once the container took on the scale necessary to house the robotic arm, there was a great deal more air to absorb moisture. In addition the internal temperature was somewhat higher than the cold/dark storage locations used in testing. While I had a warming pad under a metal container of water to keep the humidity up, the work still dehydrated faster than intended and by the final day was incapable of growing life except in some small pockets.

One step of the UV sterylization period of post-production sanitation

A Thousand Hungry Eyes at Salzamt, AT for Poetics of Obsollescence May 2022

Photo: Idiara Di Benedetto

2. Intermezzo

between the unseen. the visual flesh.

A Thousand Hungry Eyes

As a counter to the explorations of the unseen self, I want to briefly present a work that focuses very specifically on the visual organ of the body. Gabriella Garcia of *Decoding Stigma*[21] explores the ways in which those involved in erotic labor have always been at the forefront of technoscience[22]. From the early appeal of stereoscopes, to the first payphone, to the development of online streaming, these workers are often neglected or actively removed from the history and attempted futures of interactive technology[23]. It is specifically on the uses of the stereoscope that my work, produced in dialogue with Garcia, focused. In *A Thousand Hungry Eyes*[24](2021) I was designing a merger of the traditional stereoscope with modern virtual re-

21 https://decodingstigma.tech/

22 Danielle Blunt & Zahra Stardust (2021) *Automating whorephobia: sex, technology and the violence of deplatforming,* Porn Studies, 8:4, 350-366, DOI: 10.1080/23268743.2021.1947883
Zahra Stardust, 2020, *What can tech learn from sex workers? Sexual Ethics, Tech Design & Decoding Stigma*, https://medium.com/berkman-klein-center/what-can-tech-learn-from-sex-workers-8e0100f0b4b9

23 https://thebaffler.com/salvos/no-sex-for-you-gold

24 Baudelaire writes, "a thousand hungry eyes...bending over the peep-holes of the stereoscope, as though they were attic-windows of the infinite."(1859)

ality (VR) through an ePaper stereo display that updates with user motion. While constantly improving, the media of ePaper is inherently slow to update, with a minimal color palette, but potentially quite high resolution. The limitations prevent a device that provides any immersion truly equivalent to VR, so any environmental world view would not be possible. In speaking with Garcia however, she mentioned that her discussions on the convergence of modern technoscience and erotic labor frequently begin with a discussion of how this imagery was fundamental in driving interest in the stereoscope. In this way it was decided to use public archival imagery to produce a device that flipped through 60 years of imagery as the viewer rotated their head. My work on this piece was primarily on the technical side, and for further discussions on the theory, I direct readers to explore the work of *Decoding Stigma*, *Hacking Hustling*[25], or any of the research by those far more involved in the field.

25 https://hackinghustling.org/

Selfies in Self-perception

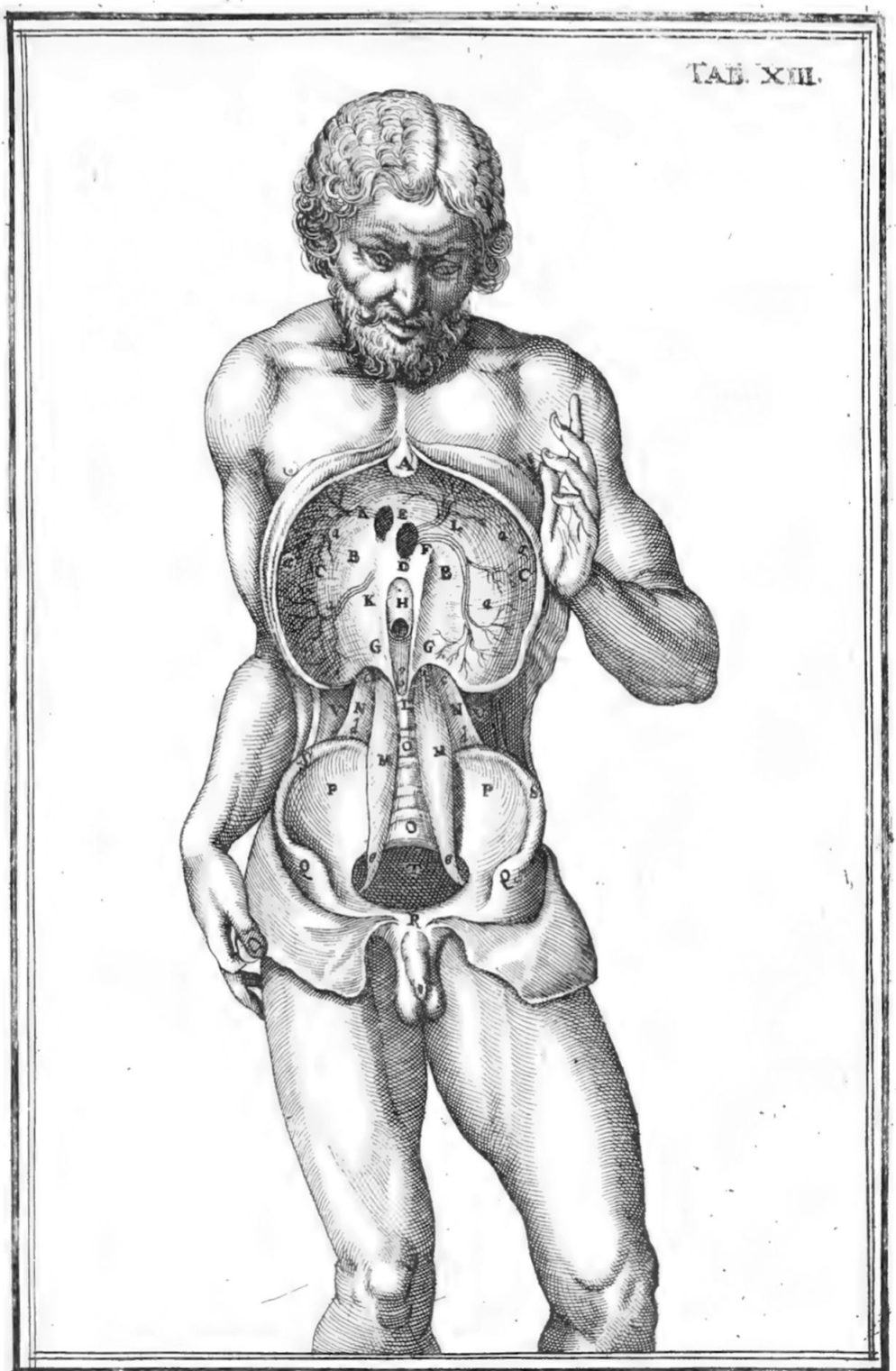
Much of media these days comes in the form of social media. While traditionally the focus on the flesh was the exploration of the other – whether portraiture or tabloids – social media has somewhat turned this on it's head. In efforts to show one's life to others, and thus market the validity of one's existence, the selfie, or self photograph, has taken a place as a dominant form of media. It is not new that perception of the self has been visually driven, as mirrored objects and reflective pools have, since antiquity, been a means of visual self-assessment. Neither is the now-called selfie a new concept – the self portrait has long been a tool of the artist most notably taking off in the 15th century of the Renaissance, driven in part through technological advancements in the production of mirrors[26]. The egalitization of the self image was technologically driven again through the advent of photography, yet it was not until modern digital cameras on handheld devices with online connectivity that such imagery could be popularly distributed on a grand scale. It is as an antithesis to these views that the prior and following works exist. They are both selfies of a kind, but highly abstracted. They portray what mirror and camera cannot (although it might be argued that the X-ray is no less a camera). The first work presents an extracted view of the bacterial self, the following - an abstract (and speculatively false) view of the interior organs of the self.

26 Self-portrait. (2023, Jan. 9), In Wikipedia. https://en.wikipedia.org/wiki/Self-portrait. Accessed Feb 2023

Removing Layers

Interestingly, while I present the principle works of this thesis as primarily representations of the body minus the skin, it might be better considered that they are the body without the visual layer. As such, the most common visual layer is not of the body, but upon it in the form of clothes. It is the removal of clothes – the making public of the private, that defines pornography (in many, but not all contexts). Perhaps, then, in the next section on portraying the body without the skin, I present another form of pornography?

> What pornography and art do share in common is this: [...] they consist of representational practices that both render what is historically private, that is, a relation between a very limited and select number of individuals into a publicly and anonymously accessible form, and that veil naked bodies through a representational structure that makes their image, their diegetical content, as desirable or appealing as their materiality. Both pornography and art produce nudity as a form out of nakedness as a content. Theirs is not a project of dematerialization (from real to representation) but a process of rematerialization – the transformation from one mode of materiality (flesh) to another (paint, canvas, photographic paper, choreographed movements).
> (Smith and Morra, pp.197)



FROM: ADRIANUS SPIGELIUS BRUXELLENSIS, DE CORPUS FABRICA HUMANI, (1543)

3. The Interior Self

a blending of the unseen majority of the human organism – highlighting inner similarity.

Exquisite Corpus

Abstract

We humans, regard our bodies through their visual surface components. The interior, when considered at all, is typically only due to medical concern for one's-self – rarely envisioning that of others. While radiological tools have dramatically improved our capacity for noninvasive representation, their use is often confined to the domains of personal health. This work seeks to instead uncover the possibilities they represent to show the full scope of our bodily form. In their obfuscation of the accustomed visual boundary, they remove associations of race and many aspects of gender. To further the dissolution of perceived identity, it excavates our inner sameness through algorithmically merging bodily interiors into 3d human chimeras – hybrid beings existing beyond the possibilities of genetic merger. Through the collection of simple participant biometrics, blended avatars constructed from real patient data are selected based on similarity to give viewers a bodily representation that extends beyond the surface manifold commonly regarded as the self in both physical and virtual worlds.

Introduction

This work existed through a meandering process, but always one that was predicated on the ability to explore the body in the absence of the biases inherent in visual layer. The multi-fold intents resulted in convolution of thought directions until eventually cohering into the present form. In showing the interior organs as radiological 3d imagery was this also to be a work that speaks to difficulties in conceiving our bodily interiors outside of the pathologies through which we most frequently see them? In using machine learning to interpolate data, was it to become yet another piece in the cannon of AI art – existing as a critique of the potential pitfalls of the technology? While the prior considerations and more weighed on the entire process and a great deal of research was done within their scopes, what it became instead was more a consideration of the human representation in the physical world through the space of virtual avatars.

Background

A Brief History of the Illustrated Interior

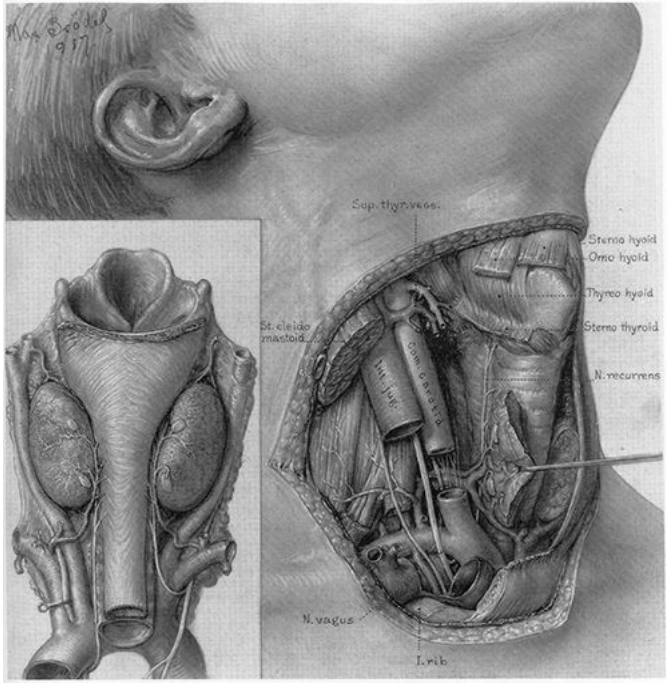
Through much of recorded history, artists have been illustrating the interior of the human body. Often this is for medical illustration, *historically* more often for depictions of torment and death. Beyond these, the creative agency given to the interior was in the means one might use to control their interior and typically outside of the visual realm. As Fraser writes in *The Body: A Reader* (2004), *"From the earliest times, human modulated the inner rhythms of their bodies; clay seals depicting yogis were found in Mohenjadaro and Harappa, Pakistan, cities as old as Babylon." (pp. 4)*

The earliest known instructional illustrations appear in 4th century BCE Alexandria.[27] These advanced through time into the naturalistic representations of what became known as *The Renaissance* culminating in the publication of the *De Corpus Fabrica Humani* in 1543 featuring highly detailed representations, in often allegorical pose.[28] This was followed in the 18th century by the works of Berhard Siegfried Albinius with the illustrative assistance of the Dutch engraver Jan Wandelaar such as *Tabulae Sceleti et Musculorum Corporis Humani*. The invention of color printing techniques in the 19th century later allowed a blos-

27 Demarest, Robert (ed.). *History of Medical Illustration*, AMI 1995.

28 See front image plate of this chapter

soming industry of medical illustration to come forth, driven in large part by the illustrations of Max Brödel, who became the director of the *Department of Art as Applied to Medicine* at Johns Hopkins university.



Brödel. *Surgical anatomy pertaining to a thyroidectomy procedure.* 1917

A Brief History of Medical Imaging Technologies

Roentgen, *Hand mit Ringen*, 1895

Radiology is a comparatively new field in the representation of the interior. Developed after and through the growth of the intermediary level of the photography thereof, it became a means of technological interface that was perhaps the first to not touch our senses directly. Only in the interaction of the unfelt/unseen X-ray with photoreactive paper were we first able to reveal the unseen body without physical interference. In 1895 Wilhelm Conrad Röntgen first produced these X-rays, later using them to provide the first look at the bone structure of the living hand through that of his wife Anna Roentgen in an image entitled *Hand with Rings*. *"Before long, and for much of the 20th century, imaging of most of the skeleton with a radiographic skeletal survey was routinely performed in a search for metastases, evaluation of myeloma, and in other conditions such as tuberculosis"* (Moran, 2010, pp. 11,12). As what became also know as "nuclear medicine" developed, so too did tools which has less of the harmful potential in-

cluding magnetic resonance imaging (MRI) and the use of inaudibly high frequency sound reflections known as ultrasound. With the expansion of computing technology, these technique were further expanded to produce three dimension representations of their subject

> Humans adorn their bodies and construct theaters and gardens in which to display them. But we also work on the very substance of the body. Artistry supplies for body parts cut off; artistry also cuts into and cuts off the substance of the body. (Smith and Morra, pp. 75)

Creative Depictions of the Interior

As may be clear from the above histories, the majority of the representations of our interior have been purely within the contexts of the academic and most frequently pathological study, with the absence of the little referenced illustrations that might be focused on the morbid.

> ""The human being under the skins" is for all lovers a horror and unthinkable, a blasphemy against Got and love"
> "We artists," Nietzsche says. We leave our kidneys, the pancreas, the liver -- and we become artists. From the beginning, from the earliest rock carvings, we humans have been leaving things out in our picture of each another. (Fraser, p.86)

However, it has been through the visual wonders provided by this growth in medical imaging technology that many artists have been provided in-

spirations to present the body on this level. The abstractions these technologies provide are more permissive to show the body's organs without the horrors of the physically opened body. Conversely, this sanitization has allowed many artists the opportunity to re-reveal the physical systems of the body as a creative provocation. Christian Möller's *Backbone (1996)* bridges this, somewhat, through an abstracted but very real human body. Taking the human (Joseph Paul Jernigan, sentenced to death in the Huntsville Prison in Texas) as portioned into over 1800 slices through a sliding projector and screen system which presents each slice as a location in space from the original complete body. These slices present the aforementioned morbidity that one experiences in seeing the interior. The slices of a radiology scan have no such affiliation, they are black & white (or *false color*), and visually removed from associations with the grotesque.

A quite different view of the interior comes, once again, from Stelarc. In *Stomach Sculpture* (1993) a capsule housing an endoscopic probe was swallowed to allow a view of the interior of the artist's stomach, producing a 'sculpture' that was, *"not for a public space but for a private physiological space - and empty organ."* (Stelarc[29]) In this work, we have several divergences from the prior. It is showing a *functional* and *living* interior of a human. It is, as well, far less abstract, except on the levels in which the interior is unfamiliar. At this point, a fairly large percentage of the population has seen such footage through the medical pro-

29 http://www.stelarc.org/?catID=20349

grams of mass media, so that is perhaps less significant, but now that familiarity brings it to a point that makes it *almost* medical, except for it's been done by an artist and not for any medical purpose. It manages to step a bit away from the medicality through something of a dance.

> Once inside the stomach, there was a simple machine choreography with the sculpture opening and closing, extending and retracting, with a flashing light and a beeping sound. (ibid.)

Yet, this dance is unseen. What is seen is only the video feed the dance produces, with adjusting views of the stomach and their activation/dis- activation through light. As such, it still maintains an aesthetic of medicality and still borders on the grotesque, whether a familiar form or not,

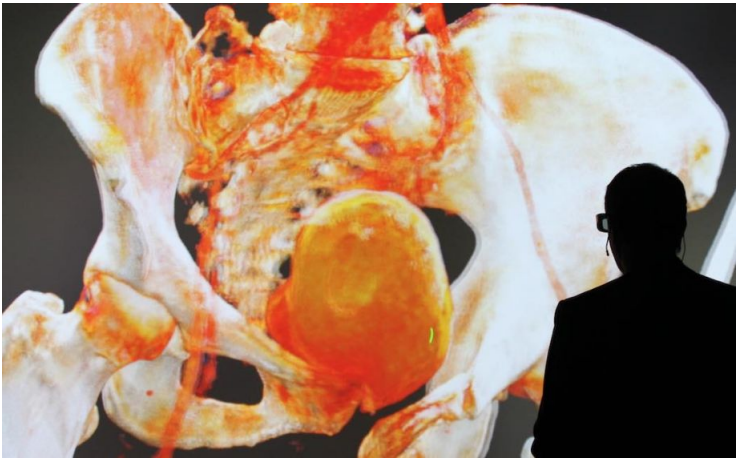
Moving to the present, we now have experiences such as *Virtual Anatomy and Pathology at Deep Space, "a project designed to utilize the data generated by [radiological] devices to deliver faster —and, above all, better—visualizations."* providing a *"combination of virtual reality technology and medical science."*[30] That this work is regularly presented to school children and researchers alike demonstrates how much more palatable these abstracted visualization technologies can make the unseemly interior.

30 Univ. Prof. Dr. Franz Fellner, director of the Radiology Department at Linz General Hospital, and researchers of the Ars Electronica Futurelab; https://ars.electronica.art/futurelab/en/projects-virtual-anatomy-pathology-at-deep-space/

To continue to explore the interior medically, while also returning to the artistic, a recent work echos some of the originating technological planing for my work – the use of ultrasound imaging to live-generate the interiors. *UNBORN0x9,* produced in collaboration between *Labomedia* and *echOpen* is described as, *"an art installation questioning the development of foetuses in artificial wombs outside of the body (ectogenesis) and the cyborg future of parenting,"*[31] It merges an artificial "womb" with a contained model fetus – monitored through robotically controlled ultrasound. In it's exploration of future potentialities of a technological womb, it externalizes the entire unseen process that is our development in our first months of life as we become human selves, yet still incorporates the radiological tool of the ultrasound to assess it even as it is now visible. The production in this case is only speculative, however, and does not present any interior from an existent being.

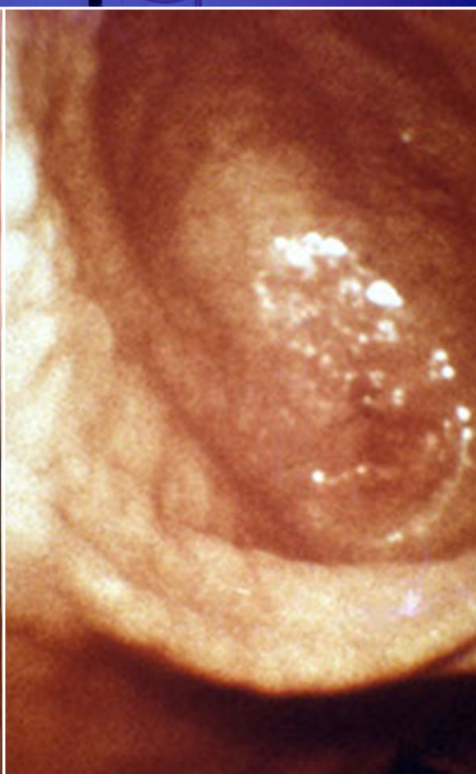
31 https://unborn0x9.labomedia.org/

Christian Moeller, *Backbone,* 1996



Virtual Anatomy and Pathology at Deep Space

UNBORN0x9 2022 – OPEN SOURCE BODY, « MORE THAN LIVING » EXHIBITION, PARIS



STOMACH SCULPTURE, 1993

The Body's Virtual and Alternative Representations as the Avatar

It's interesting to consider the avatars of virtual worlds in context with our perceptions of self in meat-space. These can take any form, and have allowed games players to explore a range of alternative existences to include the gendered, trans-species, multi-species chimeriscisms, and trans-humanist existences. However, they encompass a mostly limited visual extent (minus a small proportion of experimental work), with only hearing as an additional acknowledged sense. Haptics are limited, as are temperature, smell, propioception[32] (in most cases), adjustments to gravity, or acceleration, etc. In fact, it is their absence which provides a safety and security to virtual space – you cannot be hurt, or suffocate or fall ill within (or through) them. But it is also why they are absolutely impossible to exist in with any form of permanence. They lack the needs of the body such as air, food and water (and the expulsory needs of the body cleaning itself). Consequently, there is no need for the interior to exist in any format for these avatars. It is in this lack of practicality that *Exquisite Corpus* exists. It provides an avatar, but one that features *only* the internals unneeded in it's occupied region of the technosphere. Its volumetric form, however, also gives the possibility that the body can be not only the avatar, but the world. While the resolution of the work is inadequate at

32 *Propioception* relates to the ability to sense the position of body parts in space and in relation to each other

present for fine detail rendering, one can absolutely zoom in and move through these models as multi-tier landscape.

This idea has been addressed already by Jill Scott through *Interskin* (1997) in which, *"internal and ephemeral desires for transformations of the body are effected by the digitization of medical imaging and computer mapping of the interior of the human body."(Scott, 1997).* Two players (mediated by a third) could take avatars through different body parts to explore notions of gender and identity, but this work was avatars through a body, not bodily volume as avatars. That these notions of the interior do not exist in the virtual space only accentuates that the avatar is as-yet wholly reliant on the physical body, and that no matter how wild the de-re-anti-anthropomorphisms of the virtual space, the players remain tremendously self-similar in interior topologies to every other. That is to say, much like their real-life selves, the visual expressions of the avatar, no matter how distinct, all share the common inner forms of the users.

As artificial intelligence advances, we find another form of being that is recognized in the absence of its physicality. AIs in many mid to late 20th century science fictions were presented as disembodied voice such as that of HAL 9000 in the film *2001: A Space Odyssey* (1968). What we see now is often their disembodied artistic creations such as those from drawing prompts in *Stable Diffusion* or *Dall-e*. While these tools and affiliated chatbots are often at the forefront of media coverage of AI, it should be noted that it has as well been present (in various capacities) through non-player-con-

trolled characters in video games. As the capabilities of the ML driven models increases, potentially leading to an inability to distinguish whether one online is in conversation with a human, it then becomes only the physical form of the user that again differentiates. This initiates a new variation of the old concern in telepresence – trust. The original Turing Test required an ability to determine the gender of the intelligence of the other, but there is no gender to the avatar, whether human or computationally controlled. Extending this offline and into the physical realm: as robotics and AI improve, the exterior becomes even less relevant to the commonalities of humanity. Should we achieve robotic sentience, and in anthropomorphic form, should the interior becomes the most important differentiator – a proof by evisceration?

> ... the task of engineering platforms of our emancipation and organization cannot ignore the cultural and semiotic mutations these platforms afford. What requires re-engineering are the memetic parasites arousing and coordinating behaviors in ways occluded by their hosts' self image; failing this, memes like 'anonymity', 'ethics', 'social justice' and 'privilege-checking' host social dynamisms at odds with the often-commendable intentions with which they're taken up. (Cuboniks, 2018, pp. 49)

It should be considered that the same online realm which permits the social avatar, lacking in medical need, is the same one which most turn to before even a medical professional in the seeking of medical advice – at least insofar as there is no emergency situation. One could be considered a

use of telepresence to fulfill the social needs, while the other a teleinformatic use to fulfill physical ones.

Exquisite Corpse: A surrealist game

Through a combination of the idea of bodily mergers, and in attempts to keep the project from accidentally falling too quickly back into the realm of purely medical representation, it was clear some level of play was necessary in the interaction. It was thus fortunate when a colleague mentioned that the project sounded like a form of the game, "exquisite corpse" invented by surrealists including André Breton c. 1925. In this game a paper is folded into sections, each player draws one portion of a body (typically human) leaving only the marks of the edge of their section visible for the next player to continue the drawing. As each player sees only a glimpse of what was drawn before and thus the final image tends to be absurd with, for example, one intended body part become another. This work attempts to carry on this tradition, but through a multi-tiered merger of human forms, creating a non-human human. One that cannot exist, but appears no different from ones that can and do. *"While much of art merely represents the body (depicts or pictures it) at its most provocative, art also contains the possibility of refiguring, transforming, and functioning at the very limit of the body's capacities – especially if (as Nietzsche outlines) the origin of art is the very exploration and use of the body. Good art, as much as good science,*

presents us with the possibilities of bodies that are barely conceivable, that challenge and problematize the very stability and givenness of bodies, that force us to rethink our presumptions and our understandings of what bodies are."(Smith and Morra, 2005, pp. 193) I think this speaks to the sentiment under which both the surrealist's exquisite corpse and this work exist. The surreal combination of bodies through technology is most commonly considered through the concept of the cyborg, such as in Stelarc's *Third Hand* (1980-99), but these ideas and that work might be better considered through the (related) concept of the prosthetic.

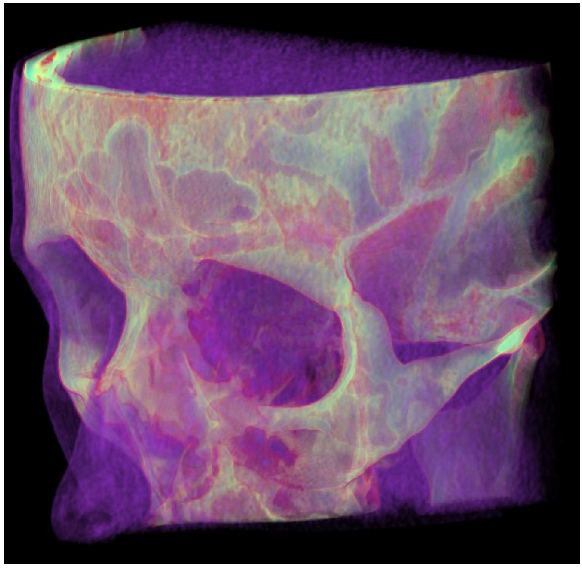
> ...unlike Donna Haraway's nonhierarchical and hybrid cyborg, the metaphor of the prosthetic and its technological interface with the body is predicated on a naturalized sense of the body's previous and privilege "wholeness". Furthermore, this corporeal wholeness tends to be constituted in purely *objective* and *visible* terms, body "parts" are seen (from an "observer's" point of view) as missing or limited, and some "thing" other(or some "other" thing) is substituted or added on the take their place. (ibid., p.22)

While in *Exquisite Corpus* the prosthetic is not the issue, there is very much the question of wholeness. The avatar in the virtual world presents a hollow shell. The chimera of mythology is fantastic for the multiple ways in which it is the sum of things incomplete, the prosthetic replaces what is lacked (including what could never have been in

the view of the cyborgian enhancement) and the exquisite corpse – it is whole through the humor that it was never meant to be so.

Process

Conception of the original version of this work began few years ago. Informing and inspiring this original idea was the consideration of the city of Baltimore, US, in which I then lived. This city has access to a high accumulation of some of the most advanced medical research facilities in the world through institutions such as the National Institute of Health and the Johns Hopkins University campus. It also has incredibly high rates of poverty and the associated poor health outcomes, related not only to crimes of physical assault but due to a long history of discriminatory po licy enacted at both the business and governmental level. As such, those most in need of the local care are frequently without access. With this in mind the work was conceived as a project in which individuals would be scanned through ultrasound, and through a custom interface, a 3d model of their interior would be generated live that they could then explore. This in turn morphed into a performative intent where movement artists would have their skins stripped away to be able to move "through" (using 'holographic' projection technique) their interiors. For a variety of reasons, this concept never made it's way further than the conceptual arena.



Cranial CT of the author's head

Through the semesters' curriculum of Critical Data, I began to re-imagine the plan. Originally, it was still to feature live ultrasound, but utilize machine learning (ML)[33] to improve the quality of the output, while still simultaneously building a three dimensional model in real time. This inclusion of the use of Artificial Intelligence(AI) and ML in radiological enhancement and interpretation became another path of research beyond the original considerations of representation the skinless body. These two together started to show clear strains as to a strong enough thread from which to draw a narrative and it was from considering what could

33 Machine learning (ML) is a field of inquiry devoted to understanding and building methods that 'learn', that is, methods that leverage data to improve performance on some set of tasks. see: Mitchell, Tom (1997). Machine Learning. New York: McGraw Hill. ISBN 0-07-042807-7.

be done with machine learning that the final concept became focused. If I am truly trying to show interior similarity, then that can be further enhanced through production of merged bodies. Thus began a great deal of research into where to find, and how to merge radiology data. This merger approach both provided the inspiration for the name - and the name further inspired the desire to give it an aspect of play in construction of these multi-bodied individuals.

Interactivity Design

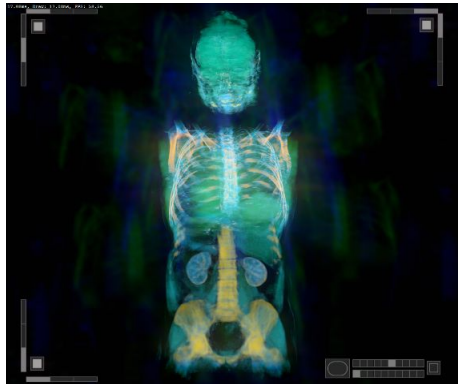
The backbone of this work was the combination of volumetric radiological data from CT (computed tomography)[34] scans which were algorithmically merged. These were presented as floating on-screen faux-voxel[35] display. This left the concept of interactivity still to be considered. In my process of merging data sets, I had found high quality data for head, chest, kidney and full torso.[36] Thus, it made some sense to continue this exquisite corpse concept to combine the datasets to make the bodies. This has resulted in two varia-

34 CT scanning is a technique for high resolution internal images using a moving, rotating X-ray tube to capture the subject from multiple angles before combining them computationally into a 3d representation.

35 A voxel is a 3d version of a pixel, where the pixel can be considered a square, an equivalent voxel would be a cube. My project only simulates this style of display through a novel technique discussed later.

36 All data was procured from collections of open research datasets. Only sets with clear public use licenses were selected.

tions based on both differing ideas for interaction, but also driven by time constraints. The first of these was presented at the *AI & Art Pavilion* for *ESCH 2022* in Luxembourg, while the other was exhibited (with some slight variations) at Ars Electronica 2022, *Crossing the Bridge* (AT) and exhibitions at Miraikan (JP) and Tokyo Private (JP).



Early interface screen for mouse interaction

Variation 1: Mouse Interaction

In this version, an individual is an active and intentional participant in constructing their chosen body. By clicking on three corner selector interfaces, they choose paired mergers for each of the head, upper torso and lower torso. In each of these there are 25 combination (5×5 individuals, with no self-pairing) for a total of over 15,000 possible bodies. This was presented on a large 'holographic' display, bringing the imagery to human scale.

Variation 2: Scanned Biometrics

Later revisions tried to more directly engage the participant through bodily analysis, without the need of tangible interaction. Here, the concept is the presentation of a model selected on their personal body. Basic body measurements of shoulders, hips, and facial structure and converted to ratios. The individual CT scans were entered into a table containing their own ratios and a new table built from the average of those values for each pairing. It is to this table the participant ratios are compared and an appropriate body selected. In this case the datasets were a 6×6 pairing of head scans and 7x7 pairings of torsos, presenting 1,764 potential matched bodies.

Physical Models

Pose estimation point tests

In developing the interactive elements, it became apparent that with appropriate software, physical forms could be isolated and printed to allow a tangible (although kept behind glass) representation. Where-as the original combinations were an array of blends, with minimal attention given to any subject data except sex determination by genital presentation, I wanted these to have a story to their metaphors. The organs were selected partially based on this ap-

proach, and partly by what was easiest to produce as a coherent object. The three selected organs were the heart, brain, and voice box. The heart was chosen to be a blend of one male and one female in keeping with attempting a post-gender view (with of course the difficulty in presuming anything about the subjects beforehand). The brain continued this, but taking the oldest and youngest brains from their data set with one female 65 year old and one male 19 year old (data as provided by the study). With the voice box I wanted an extended metaphor. There was no patient data from the set, but I wanted to try blending three individuals instead of only two. Beyond wanting to explore the challenge and see the result, the concept was based on the thought of a vocal triad – three singers voices as one choir.

Post-processing of the volume data was carried out through the open source medical software *Slicer* to separate out the main components of the organs. These models were brought into the 3d motion graphics package *Blender* for cleanup. While I had intended to make the heart hollowed for an accurate representation of the chambers, the complexity of the form with the support needs of flexible resin printing required that I make a solid print in the end.

HYBRID ORGANS PRINTED IN FLEXIBLE RESIN. LEFT: TWO HEARTS,
CENTER: THREE VOICE BOXES; RIGHT: TWO BRAINS

Research:

Much of the production of this work, beyond the finalization of the idea, took place in Japan at the University of Tsukuba's *Digital Nature Group* (DNG). The tutelage of Professor Yoichi Ochiai was an invaluable guiding hand during this period and has also led to some potential further directions that will be discussed in the afterword. The research can be partitioned into three elements, which were handled concurrently – with the results of each modifying the progression of the others.

- Data set selection and acquisition
- Algorithms to merge radiology data
  (and novel techniques there-in)
- Means of presentation
  (interactive & physical prints)

Data Acquisition and Selection

As with many attempts to find specialized public data sets, the initial search for complete radiology scans of human bodies began very slowly. As became gradually apparent, part of this is that a full human CT scan is almost never medically necessary and the associated radiation dosage not ethically defensible. As the research turned to a more sectional approach, the work of finding data became almost too easy. This is because there is

a massive quantity available for specific regional information with a wide range of (mostly lower) qualities and almost all based on a pathology (though many with control sets[37]). A great deal of these are made public to help train ML algorithms to produce high quality scans from lower quality (and lower radiation) imagery. By the time I was producing the mouse-interactive revision, I had settled on three fairly high quality datasets to produce the head, upper and lower torso individually through public data provided by *Kaggle*[38]. By the time I was producing the latter biometric version, I had found a high quality source for full torso through *The Cancer Imaging Archives*.

Novel Techniques Used in Production:

Blending

Determining a means to blend two CT scans into one coherent human volume was tricky, but eventually landed on a re-appropriation of motion-based frame interpolation as a means to produce these forms. To my knowledge and in conversation with others in the field, there is as-yet not a developed algorithm to produce volumetric blending of physical forms beyond those

37 In this field of research, a control is an individual without the studied pathology with which to compare those who do.

38 See *Data Sources* in the bibliography for further details on the datasets.

relevant to flow mechanics. As fluid dynamics are not based on training to maintain physical structures with multi-layer manifold geometries, those could not be used. While there are, as well, algorithms to merge between surface manifold geometry, these do not handle the volumetrics needed for the variations in tissue and bone densities. To circumvent these, a new process was developed in which each pair of sliced layers were interpreted through a machine learning algorithm designed to interpolate frames in video for slow motion.

Originally I had wanted to blend using a top to bottom approach. In this variation the top of one body would gradually morph into the bottom of the other, using machine learning to build fully interpolated organs along the way. To produce such a flow, I believed the frame interpolation algorithm could potentially produce this result with minimal effort. This was incorrect. During initial tests using FILM[39] (Frame Interpolation for Large Motion), I found that the blends ended up being an entirely linear slide from one form to the other, producing a highly unnatural (and not in a fun way) result. It was also nearly indistinguishable from the much faster pixel flow algorithms in use for over a decade in many video production suites in that both technique resulted more in a final volume that looked like an overlay of the two rather than a new, blended form. I hoped that by training the algorithm on radiological data, I might be able to overcome this. As my thinking on how the blend

39 Reda, Fitsum, et al.. *Tensorflow 2 Implementation of "FILM: Frame Interpolation for Large Motion"*, 2022

should exist evolved, In this time I was introduced to Shane Gu of Google Research[40] by fellow DNG researcher Naruya Kondo and Professor Ochiai. The conversation led to several venues of potential future research, specifically volume-based training using signed distance fields, but this was outside of my knowledge and ability within the necessary timeframe. Unfortunately, the only pre-existing 3d interpolaters were for blending manifold geometry (surface structures), and those within the field of voxel-space radiology data, only exist to enhance, not merge, given imagery.

Without the skillset to produce my own algorithm to bridge this gap, I went back to re-appropriating FILM, but from a different direction. In the new version I conformed the data sets to approximately equivalent proportions and orientations (after recording original proportions) and sliced them into equal numbers of layers. These were then used to produce an interpolated middle between the slice pair at each height. Besides a certain amount of wobble where the algorithm decided to switch the directions it shifted pixels (since it was unaware of the results of the layers above or below) this produced results which rendered quite satisfactorily. Some organs became somewhat blurred as will be discussed in the results.

40 Shixiang Shane Gu (顾世翔), Senior Research Scientist, Google Research, Brain Team

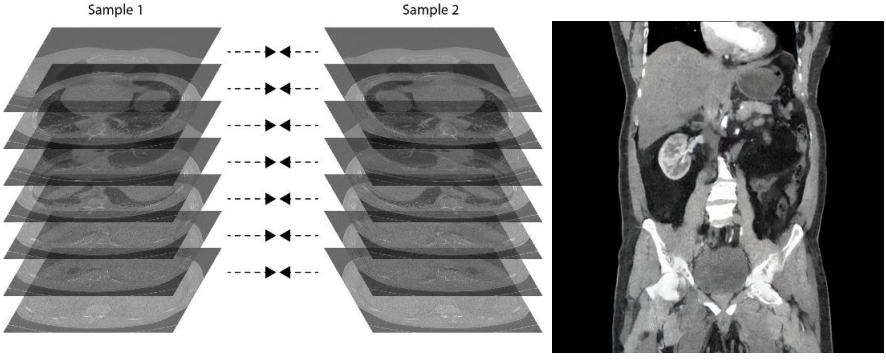
Rendering

The second development is not entirely novel, but infrequently applied. This was to build a custom renderer technique using stacked transparent images to represent the volumes. Typically, this would be handled with some form of voxel renderer. I opted instead to design this custom display for the following reasons:

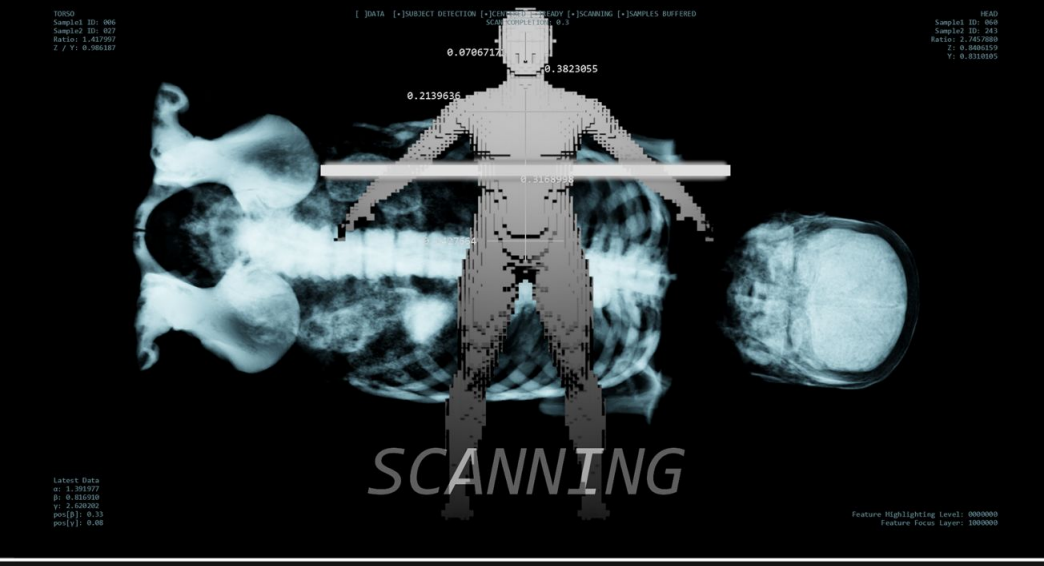
- Render speed: once the image textures are loaded, the renderer need only deal with a number of textured polygons (n=1024) rather than a much higher number of voxels (>250 million)
- The above allows that good frame rates can be maintained on modest hardware such as a mid-tier gaming laptop/desktop.
- This technique provided a very good result even with the fairly low resolution image data (typical of the format). Any attempt to upscale with hardware or use higher resolution imagery would have exceeded the graphics memory of the available hardware
- Color transforms can take place easily within graphics cards, and I could thus have dynamic texturing on my output to feature different strata/organs of the bodies.

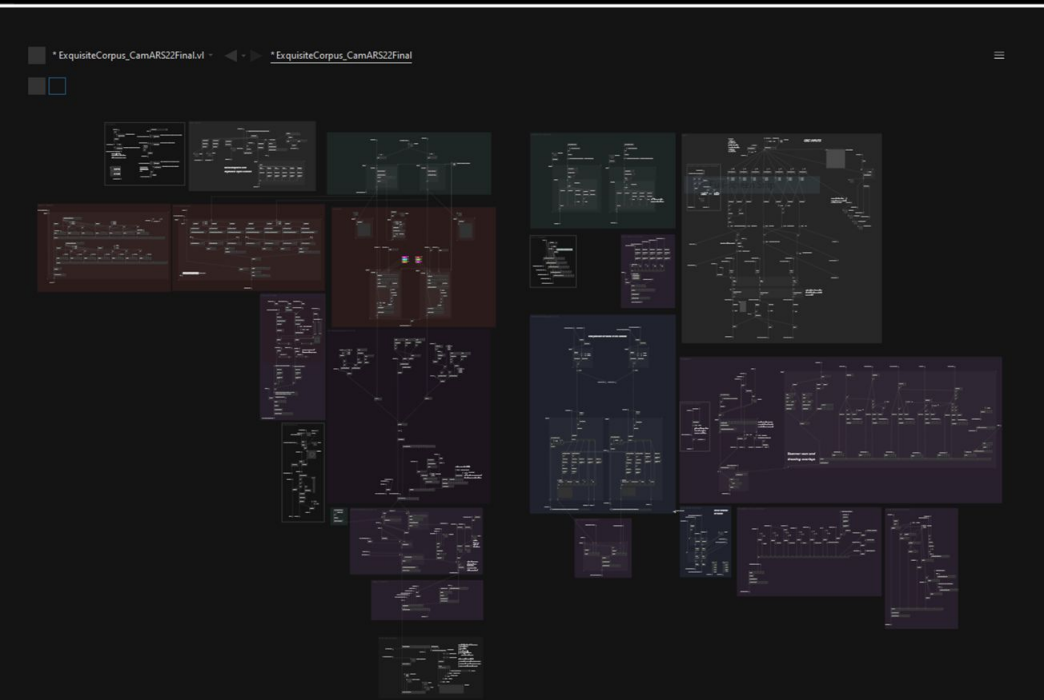
The limitation of this technique is that if the 3d form rotates too far, the polygons, having no inherent thickness, disappear when viewed on-edge. Fortunately, I did not need fully rotating models, so this was largely irrelevant to my purposes. Regrettably, loading the texture data to

memory can be a very slow affair each time a new model is loaded, but this would still be the case in other rendering scenarios. This was mitigated through a bit of sleight of hand in which the device claimed to be calculating a new merger, when in fact is was loading one.



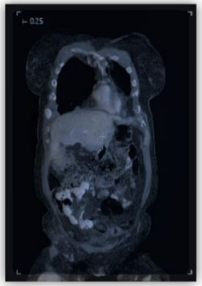
Left: visual diagram of the merger algorithm; Right: A merged slice from two individual torsos



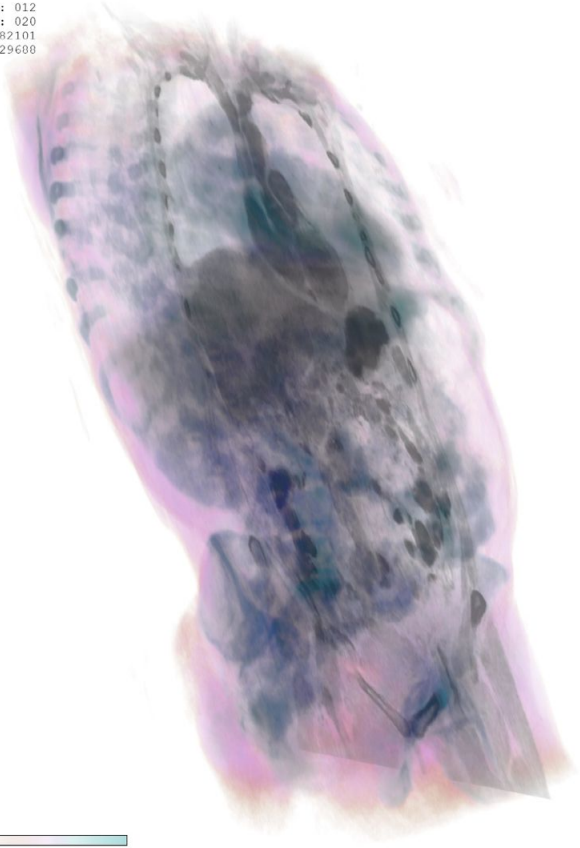


TOP: DARK SCREEN VIEW SHOWING VIDEO OVERLAY DURING BIOMETRIC SCANNING.
BOTTOM: OVERVIEW OF THE VVVV PATCH USED TO PRODUCE EXQUISITE CORPUS.
OPPOSITE: THE LIGHT SCREEN SHOWING THE SEPERATE BLENDED HEAD AND TORSO.
IMAGES LEFT AND RIGHT SHOW CORONAL SLICES OF EACH.

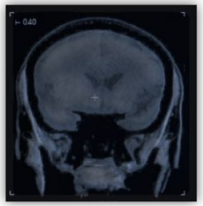
STILL FROM EXQUISITE CORPUS, [UPDATED THIS EDITION FROM SIGGRAPH ASIA 2023 REVISION]

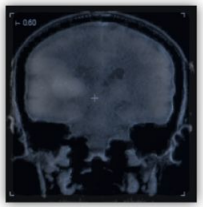


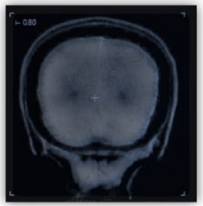
TORSO
Sample1 ID: 012
Sample2 ID: 020
Ratio: 1.682101
Z / Y: 1.029608



HEAD
Sample1 ID: 058
Sample2 ID: 266
Ratio: 3.136724
Z: 0.797241
Y: 0.890244







Results

Blending

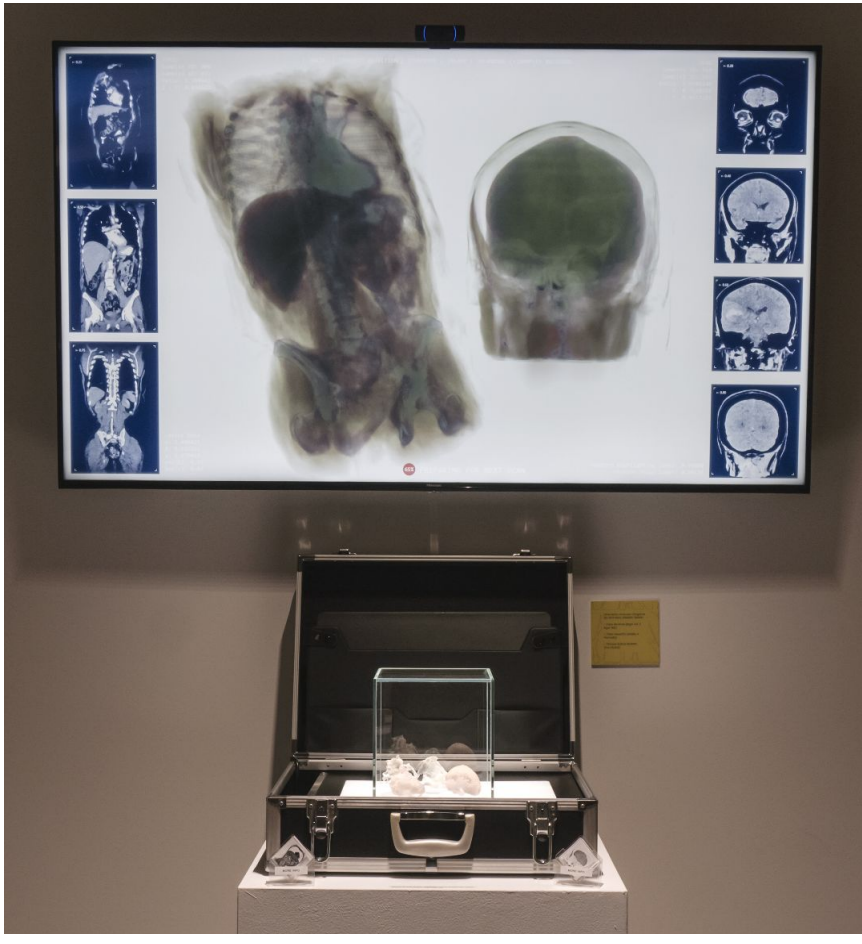
The output bodies were interesting. As the algorithm worked on a layer-by-layer basis, it had no knowledge of what was 'above' or 'below'. Given the somewhat fickle and stochastic nature of AI algorithms, it thus would produce a bit a wobble at each layer. If this was displayed as an image stack on a different axis than the one which was used during interpolation, this manifested as a clear, if slight, visual tearing. This could be improved through better initial conformation of data. Those areas with sufficient variation between individuals was the most vulnerable. The variation in intestinal turns, for example, frequently seemed to become a bit of a blur, as would to some extent, the blended genital areas of differing sex organs. I did notice that algorithm would prefer to keep something that was there more than remove it, although in a distorted form. For example, although I made it so the soft tissue such as skin was not particularly visible, one can see the larger breasts of a pairing which had two scales, or even the remnants of both penises in a pairing of two males (as these never hung in the same position on any two scans)

Presentation

On the presentation side. I was unable to witness the experience of the mouse-interactive version as I was not present in Luxembourg for it's exhibition. In discussion with colleagues from Interface Cultures who were present, it worked well as far as the interaction with an important caveat. Those I spoke to had been told how to interact. It seems, from their reviews, that perhaps by making the interactive buttons too much a part of the design, they might not have known they were to be interacted with without being prior informed.

The biometric scan version I am happy to say, primarily worked with few issues. As per my experience with many interactive pieces, the interaction must be painfully clear, or painfully spelled out. As the interaction for mine was not entirely clear from the description, I added labels to try to better alert viewer to become potential participants. From the ample time I was nearby (without alerting viewers to my presence) I witnessed that this mostly worked as far as directing them to the appropriate interactions. The exhibition setups in Tokyo for the shows at Tokyo Private and Miraikan had favorable reviews, but I was again unable to be present for first-hand experience or discussion. I received several positive reviews of the work including from a returning teenage student choosing to write their school report on an Ars Electronica Festival project on mine (and bringing friends along each time), one of the jurists from the *Interactive Arts* category of that year's festival, and a PhD researcher who's specific focus was on

(as best as I remember) something in the vein of interactive, medical technology-based art who stated they had never seen a similar subject matter in their research.



Installation setup for *Crossing the Bridge*, Ars Electronica 2022

Photo: Digital Nature Group

TOP: INSTALLATION AT MIRAIKAN, TOKYO FOR
DIGITAL NATURE GROUP XDIVERSITY EXHIBITION
LEFT: HOLOGRAPHIC DISPLAY INSTALLATION AT ESCH2022. LUXEMBOURG
RIGHT: CLOSE-UP OF ORGAN PRINT DISPLAY FROM CROSSING THE BRIDGE

Photo: Manuela Naveau

Lessons

Processor overload

My rendering technique fairly well used all available GPU and local RAM. This occasionally led to a delay before the pose estimation would register that an individual was attempting an interaction, but usually would respond before they gave up. Still, on occasion I stepped in to inform participants that it takes a moment to register at times.

Appearance

Bodies really do generally all look the same inside: While *the point* of the work's thesis *is* that we share a great deal of inner sameness, that doesn't always make the most engaging interactive response. In many cases, it was not dramatically apparent the body had changed at all. I believe my attempts to add text to make the interaction more obvious as well as the switch only drew attention away from the changes which were themselves fairly subtle. This could be fixed by introducing subjects with implants, pathologies or other known irregularities. I did not, however, want to

draw attention back to the scans from the medical and pathological perspective. Similarly I did not want to exploit data from individuals' medical traumas. Perhaps more simply, just adjusting the results for participant size, rather than only ratio would have provided sufficient additional variation.

A more minor note is the using a red circle for the time between scans that turns green in the bottom center of the screen is a visual paradigm used in phone and tablet cameras that might imply a touch screen – although I only witnessed one interaction attempt of this type.

4. Contextual Analysis of Microbiospheric Engineering with Exquisite Corpus

The works presented here exist not only as the specific views of these layers, but as metaphors for how we as individuals see each other, interact as a whole, interface with the world through technology and further use that technology to explore the world and ourselves.. Clearly we don't see ourselves by the bacterial layer, any better than we see the interior layer, but both of these work in concert to produce our living selves. The bacteria colonize our bodies, and do so in a manner that is semi-automatic – lacking any judgement between each other besides those of nearly robotic signals (although, in the chemical, rather than electrical domain). In the meantime we colonize the planet (with ambitions to colonize that which exists beyond its bounds). While our interactions are far more complex, and should not be considered automatic, our visual biases frequently result in automated responses to each other. Perhaps in their removal, we might begin to behave as non-destructively to each other and our host planet as (the great majority of) our microbiological inhabitants operate in harmony with ourselves.

The microbiome exists as a form of non-mendelian partial-inheritance, while our organs are part of the direct genetic influence. The blend-

ing of individuals creates beings absent such genetic determinism, and brings closer the idea of the multitudes of co-participants in our existence that is our microbiome. To continue in the vein of inheritance, it might be considered that what is typically rendered visually is the inheritance only through what is known as *sexual* selection,[41] while the interior is the more often considered *natural* selection while the co-evolution of the microbiota represents again natural selection but on the hologenomic[42] scale.

It may be considered that while the latter work is not fundamentally about or considering robotics, that in the production of robotics, especially those with anthropomorphic features, we are once again in a realm where what features are represented becomes critical. As lifelike systems are produced, there will then be a counterpoint in that, in those systems, the exteriors shall be familiar, but the interiors wholly alien.

In the colonization of our planet, we have enlisted vast machinery to monitor, extract, till, and reshape it. This scale becomes inverted in the metaphor of *Microbiospheric Engineering*. But, large external machines are exactly what is used to produce volumetric radiology. To learn our interiors, we first must be fed *through the interior* of

41 *Sexual selection* is a subsection of the theory of natural selection that accounts for continuation of traits based on ability to mate rather solely than ability to survive. This can include in many species the growth of visual characteristics that become visually 'attractive' yet are not of any practicality to survival.

42 *Hologenomics* theorizes a genome as consisting of that of all symbiotic organisms constituting a body.

the machine. Of course some of this dialogue can already be found in regard to both the interior and exterior interfacing with technologies in conversations about prosthesis. This also takes on a form of the unseen existence in the body – first in that many prothesis are defined by the unseen, replacing what is not there – and second, that many, such as pacemakers or hip replacements, exist as implants and are thus unseen and largely unknown to those beyond their immediate need..

Looking again at *UNBORN0x9*, we see a work which bridges my two pieces, although with a different purpose. Much like *Microbiospheric Engineering*, it takes a symbiote (the child – mendelian rather than bacterial) removes it from the host (the womb – interior rather than exterior) and places it in a context of a foreign host (artificial womb rather than host world) and monitors it robotically (ultrasound rather than microscopy). Meanwhile it echos elements of *Exquisite Corpus* in that is shows an element of the interior (the artificial developing fetus model) and brings it to the exterior, by monitoring through radiological methods. This all said, while progeny are our present means to continue our populous upon the planet, the crux of my works is focused on de-visualizing the skin, not on reproduction except in the very limited scope of the far more rapid bacterial population growth and it as metaphor for our own.

Returning to *Stomach Sculpture*, we see another conceptualization of the host with what is unseen. *"The hollow body becomes a host, not for a self but simply for a sculpture. As surface, skin was once the beginning of the world and simultaneously*

*the boundary of the self. But now stretched, pierced and penetrated by technology, the skin is no longer the smooth and sensuous surface of a site or a screen. Skin no longer signifies closure." (*Stelarc). In this case the, the device allows the view but is itself not seen.

What *UNBORN0x9* also brings up is the influence of technology on growth and the process of age. In discussions on the avatar, the virtual age may be selected, but is frozen (unless the player opts to adjust it). In the form of the fetal doll, this is also true, and even my blended chimeras, while made from persons of different ages, is still an immutable result. This does not mean the avatar does not present a change or growth, partially, this is in the fact that the controlling individual is still changing

> When we project ourselves through a different body, we change the way others see us. If we persist in a different physical form, in time we will absorb the community's view of our "self," and the self must be changed by this process. This is not mimicry or impersonation or acting. When the self has adapted to this new environment, it is as true as it ever was. We do not accept that there is a ground truth," given say, by our embodied forms at 25 years of age. All bodies change. Aging changes us continuously. Injury and sickness may change us suddenly. The jet pilot's "personality" as projected by her flying style may contrast sharply with her ground (face-to-face) personality, or with her personality as a driver in rush hour. (Goldberg, pp. 293)

And simply because a change is not seen or known, does not negate there is a level on which it is experienced and interacted with. Even our populations of our micriobiota change throughout our lives and the effects are only now beginning to be understood.[43]

The progressions here presented look to expand our evolutionary senses through metaphor. In the first, through a greater expansion of the considerations of how we interact with our environment and how we might expand our habitable environment by attention to how we exist *as* an environment (host) while the latter shows neo-evolutionary concepts through post-genetic hybrids. While, *"In Stelarc's commentaries, technology is always conceptualized as environmental, never as a species in itself. The scenario is one in which the human body has moved toward a condition of potentially terminal unfitness or maladaptation because of environmental changes of its own making, yet at this very crisis point it may discover a radically new evolutionary direction." (Smith, 2005, pp. 2)*, these works present the human species as body *and* environment to demonstrate evolutionary directions. Perhaps more strongly we can take a cue from the *Xenofeminist Manifesto*:

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43 Pasolli E, et al. *Extensive Unexplored Human Microbiome Diversity Revealed by Over 150,000 Genomes from Metagenomes Spanning Age, Geography, and Lifestyle*. 2019

Salazar N, Et al. *Microbiome: Effects of Aging and Diet*. Curr Issues Mol Biol. 2019

Zisimopoulos A, Et al. *The Role of the Microbiome in Age-Related Macular Degeneration: A Review of the Literature*. Ophthalmologica. Epub 2021

> Our lot is cast with technoscience, where nothing is so sacred that it cannot be re-engineered and transformed so as to widen our aperture of freedom, extending to gender and the human. [...] 'Nature' understood here as the unbounded arena of science - is all there is. And so, in tearing down melancholy and illusion, the unambitious and the non-scalable, the libidinized puritanism of certain online cultures, and Nature as an un-remakeable given, we find that our normative anti-naturalism has pushed us towards an unflinching ontological naturalism. (Cuboniks, pp.65)

In *Sociology of the Body*, Kate Cregan writes, "Dealing with the evidence of the body's boundaries is both necessary and dangerous to the self-constituting subject."[p.96] While this is written in the context of the more fluidic elements of the body, such as blood or excrement, I think the relevance to the works presented, not just in the consideration microbial inhabitants upon it and within it, but also in the context of the those interior components, that while no one would argue are not self-constituting, are nonetheless rarely acknowledged when assessing that which constitutes the self of another.

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Afterword

The works presented have been given as they have been produced so far, but there is still a great deal I would like to do with them in the future, some of which I am actively developing. On the microbiosphere, I very much want to fully develop the robotics – both to be participant controlled and to be able to become a part of the colonial seeding; not just the means of monitor. As well, I would like the arm to be able to present alternative vistas using pitch / tilt and focus controls rather than the simple straight down from above view as presented. There are many paths forward for the interior camera, but if transmitting live, rather than time-lapse, it could allow virtual exploration of the world beyond the robot's-eye view. Originally, although not discussed prior, there was a hope to collect regional bacterial samples from the sphere for genetic sequencing and use this data to produce a micro-global map of the bacterial genetic variation after selection through the pressures of the installed environment. The sanitation procedure requirements prevented any such sample collection, however this would be an avenue I may be able to explore in the future.

Elements from *Exquisite Corpus* are presently under development as an immersive interactive experience to be presented in systems such as the Deep Space theater of the Ars Electronica Center. This permutation uses the interior similarity metaphor and expands its emphasis to a dissolution of the self; intended for presentation as both an interactive installation and an expanded narrative version in collaboration with movement artists. Additionally, I am still hoping to use the techniques developed for this project to produce a work in which people can have *live-generated* 3d interior renderings and have been following some recent advancements that may help facilitate such an undertaking.

Update to the second edition:

As was claimed above, there has been further development of the Exquisite Corpus work, although primarily in its visual presentation. In addition to improved visual qualities, it has expanded to a large-scale immersive interactive experience as *Self Dissolution* – in which participants within the Ars Electronica Center's Deep Space venue are scanned individually to produce image slices of a radiological head and torso as particle nebulae. An additional time-based work was produced as *Corpora in five forms.* Unfortunately, I have not as yet begun the principle intended task from above of expanding the merging algorithm. The work has continued to be shown in its various permutations as opposite:

xCoAx Gallery 2023, Weimar[44]
Ars Electronica Festival 2022, Linz[45]
Siggraph Asia 2023, *Art Gallery*, Sydney[44]
Equilibrio Festival, 2024, Porto Ferro[46]
Ars Electronica Expanded Animation Festival 2024, Linz[46]

The work, *1000 Hungry Eyes* has as well since shown:

Arse Elektronika 2023, DH5, Linz

Elements from this thesis have seen publication in:

Multiple authors incl. Blackistone, K. et al., *Top-Rated LGA Abstracts 2024*. Leonardo 2025. MIT Press. *[Accepted / In production]*

Blackistone, K. (2023, July). *Exquisite Corpus*. In xCoAx 2023: Proceedings of the Eleventh Conference on Computation, Communication, Aesthetics & X (pp. 331-338).

Additionally, my thesis expanding on human technological relations within the realms of adversarial learning as musical strategy for the *Postdigital Lutherie* program of Kunstuniversität Linz, *Hostile Architectures as Algorithmic Intervention in Musical Improvisation* has gone to press.

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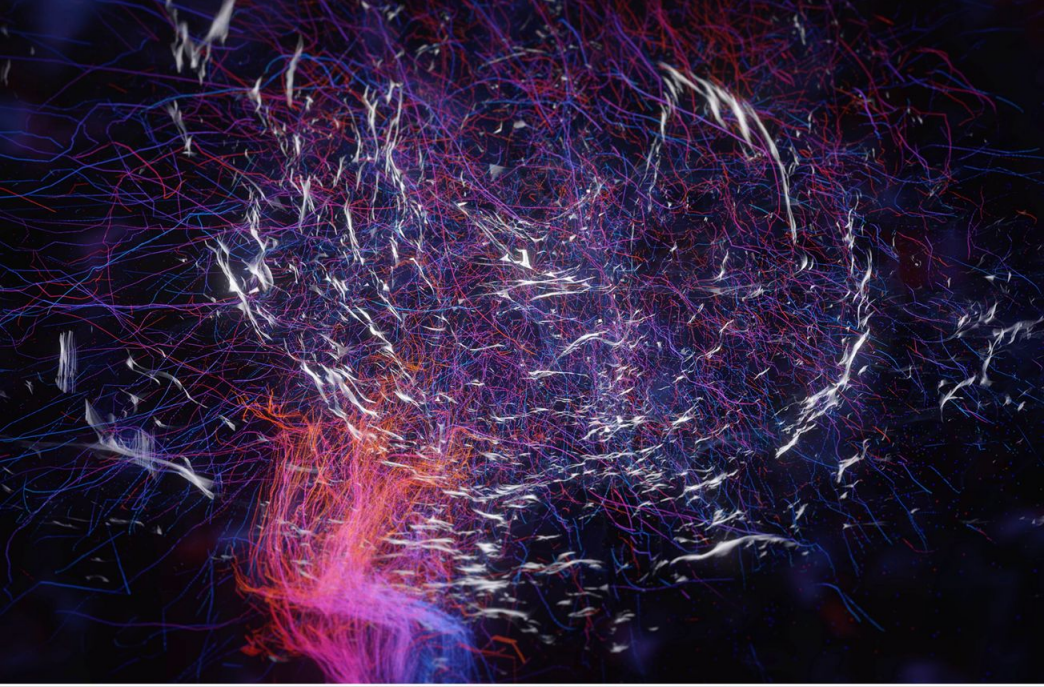
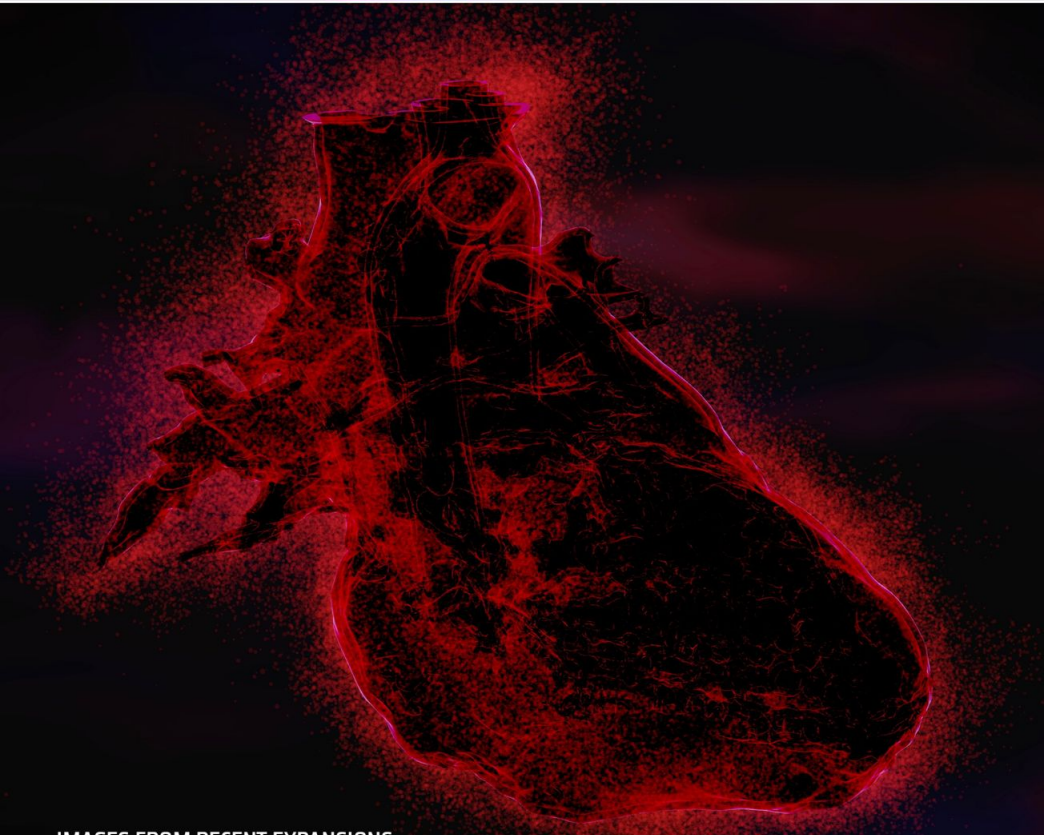
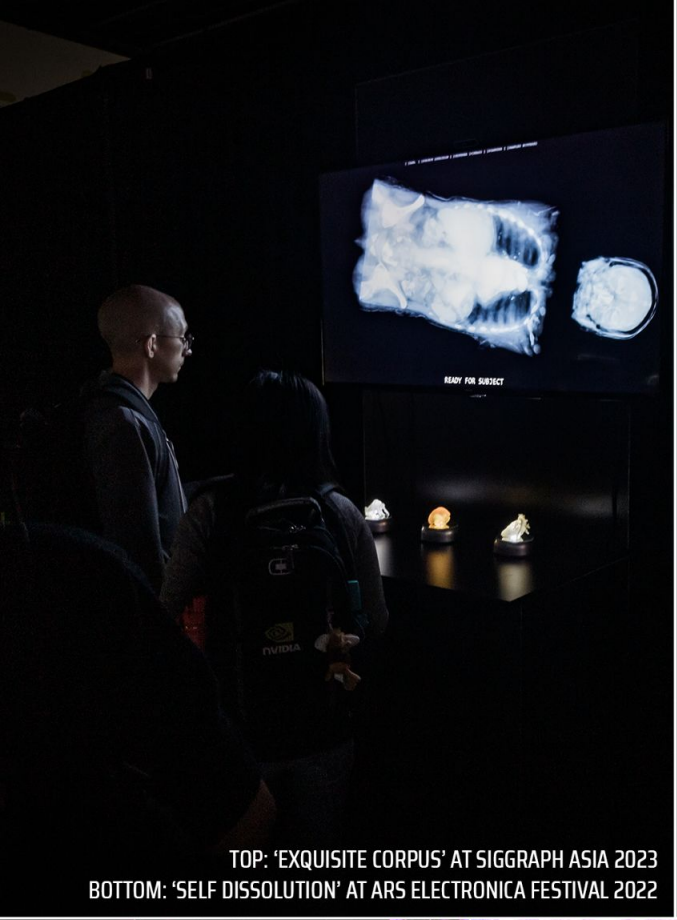
44 As *Exquisite Corpus*
45 As *Self Dissolution*
46 As *Corpora in Five Forms*





IMAGES FROM RECENT EXPANSIONS
FROM ‘CORPORA IN FIVE FORMS’ - TOP: ‘CEREBRAL GENERATIONS’
BOTTOM: ‘TWO-TALE HEART’; OPPOSITE TOP-RIGHT: ‘BREATHLESS CHOIR’



TOP: ‘EXQUISITE CORPUS’ AT SIGGRAPH ASIA 2023
BOTTOM: ‘SELF DISSOLUTION’ AT ARS ELECTRONICA FESTIVAL 2022

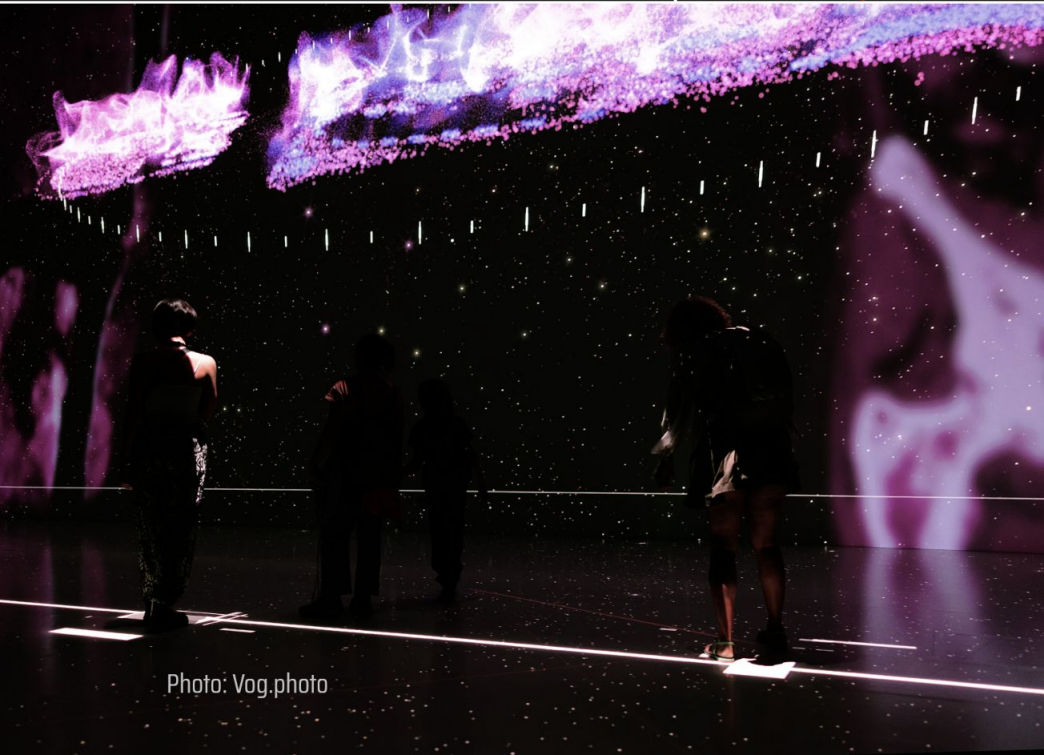


Photo: Vog.photo

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Images

All thesis work images: Kevin Blackistone unless noted.

Introduction

5 Prior works. *Radiant Flux* image by: Alex Jennings

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10 Microbes under the microscope at Ars Electronica Center Biolab.

14 Fig 386 from Arcanorum Naturae Detecta, Fig 386. Antoni van Leeuwenhoek, 1695, pp. 387. Digitized by The Internet Archive, 2019.
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30 Schema for Microbiospheric Engineering

34 Petri dishes from tests of different sterilization protocols

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37 Body regions remapped to sphere for bacterial application

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40 Installation images from Microbiospheric Engineering at Grand Garage (AT)

43 Still frame from livestream of Microbiospheric Engineering

44 Post installation sterilization procedure for above

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46 Images from A Thousand Hungry Eyes

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56 Max Brödel. Surgical anatomy pertaining to a thyroidectomy procedure. (1917). source: http://pages.jh.edu/jhumag/0400web/34.html

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62 Christian Möller. Backbone. from artist's website
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64 Top: UNBORN0x9 installation. From project website
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73 Mouse interface revision of Exquisite Corpus.

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76 Flexible resin printed hybrid organs in display case during Crossing the Bridge at Ars Electronica 2022.

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84 Sample of rendered image presentation with layer slices

87 Exquisite Corpus as installed for Crossing the Bridge at Ars Electronica 2022. Image: Indiara Di Benedetto

88 Installation photos of Exquisite Corpus
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Bottom Left: ESCH2022
Bottom Right: Close-up image of resin organ prints display.

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