

Visualizing The Unseen Body.

Architectural Potentials of Data Modeling

DR. JULIO BERMUDEZ¹

JIM AGUTTER²

DEBRA GONDECK-BECKER³

DR. STEFANO FORESTI⁴

DR. DWAYNE WESTENSKOW⁵

¹Graduate School of Architecture, University of Utah, Salt Lake City, Utah, USA

jbermudez@arch.utah.edu

²Graduate School of Architecture, University of Utah, Salt Lake City, Utah, USA

jagutter@xmission.com

³Jordani Multimedia Inc., Minneapolis, Minnesota, USA

dgbecker@jordani.com

⁴Center for High Performance Computing, University of Utah, Salt Lake City, Utah, USA

stefano@chpc.utah.edu

⁵School of Medicine, University of Utah, Salt Lake City, Utah, USA

dwayne@carf.med.utah.edu

Abstract. The project is a digital *architectural visualization of an individual's physiological data in real time*. It is both a probing and representational system that brings together science and art through architectural design. Architecture provides the conceptual and visual tools for expressing the complexities of an individual's physiological state. Visualizing the intricate nature of organic life, awakens the unfolding nature of our being.

1 Background

The project explores the ancient human fascination with the depiction of life, the body, and the self. From philosophy, anthropology, psychoanalysis, and medicine to the visual arts and architecture, we look internally hoping to grasp who or what, why and how we are (Diller 1994; Feher, Naddaff & Tazi 1989; Sennett 1994; Stafford 1991, Wentwick 1971). Our work examines these traditions in the light of the new technologies, media, cultures, and worlds.

The new visualization contributes to the evolution of digital environments by investigating the expressive making, communication, and sustenance of virtual, yet life-based, ontologies. Although there are some ongoing artistic and architectural explorations of the relationship between body and digital space (see for instance Davis 1996; Diller 1994; Frank 1995; Novak 1995a,b; Oki 1995; Scheidt & Kyr 1994; Schiphorst, Mah & Crawford 1994; Sterlac 1995; Stone 1991; World Architecture 1995), this data modeling concept is completely novel.

By focusing on the visualization of *processes and states* (i.e., body function or physiology) instead of *organic structures* (i.e., body's forms —anatomy), the project stands apart from and contributes to traditional

medical visualization. In effect, medical visualization has hitherto focused on *enhancing* anatomic images to make them more readable. This type of work needs little design effort because the organic structures already possess their own characteristic shapes. In contrast, physiologic data have no particular form and therefore demand the creation of new representations. This visualization design is therefore about *inventing new representations and not enhancing existing ones*.

2 Description

The created fluid architectural environment originates from actual data naturally generated by a living human being. It provides an identity inextricably tied to the individual because it germinates from their physiological signals. Our physical bodies inhale, exhale, beat, sweat, and shiver. These functions are uncontrollable and necessary. They are also unique to our own self. If we incorporate the fundamentals of physical being to establish virtual being, to give form and space to personal architectures, we create a personal signature.

The data is obtained from existing medical equipment that measures human physiological signs in real

time (e.g., heart rate, blood pressure, respiration, brain activity) and transformed into multidimensional form. Existing scientific visualization software is used as the modeling tool.

More specifically, we use vital signs measuring that which have been historically associated with life and consciousness:

(1)Breathing; respiration has been related to the reptilian mind, the deep unconscious, and the basic quality of physical life —Brahma. The Respiratory System supplies oxygen and removes carbon dioxide. Air flows through a series of conduction passageways that branch out from one another. Inspiration, the movement of air into the lungs with elevation of the ribs and expiration, the movement of air out of the lungs, back into the atmosphere with fall of the ribs creates a rhythmic pattern. This rhythm is altered from internal and external forces such as stress and physical activity.

(2)Heart; this organ has been linked to the mammalian mind, the unconscious, and the basic quality of emotional life — love, feelings. The Circulatory System provides a homeostatic environment for the cells of the body. Blood continuously travels a closed, circular route through the heart, into arteries, then to capillaries, into veins, and back to the heart. The heart is the pump that provides the force necessary to keep this blood flowing. Changes in the blood volume may be brought about by emotional states (fear), environmental factors (temperature), physical activity, and other variables.

(3)Brain; this organ is basic to the homo sapiens experience and to the basic quality of conscious life — thought, reason. The Central Nervous System is responsible for the integration and control of body functions. Functions range from single activation and reflex control of skeletal muscle to complex functions of memory, abstract thought, association, and language. Throughout the body, nerves (somatic receptors) receive stimuli (change in the environment) and send the information to the brain so it can react in a purposeful manner to changes in the external and internal environment.

In order to create this virtual architecture, a model for externalizing these three systems is developed. This means to establish formal, spatial, textural, light, and temporal parameters according to design principles to effectively and rapidly communicate complex physiologic data.

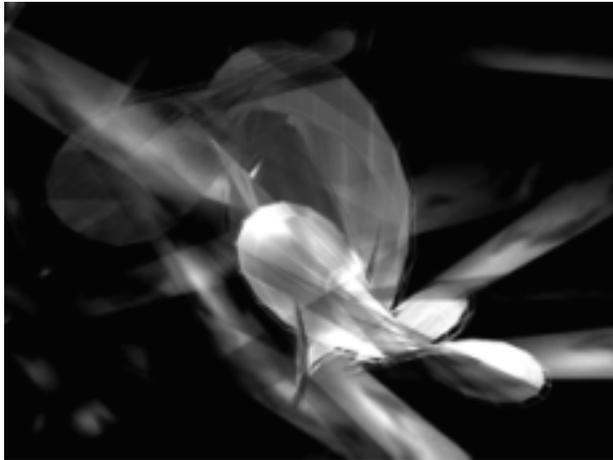
In addition to the scientific agenda of visualizing data, this effort is also an aesthetic project. It is an interactive and participatory work of art on/of the self/body that

heightens people's awareness of their own unfolding nature of being. The ancient roman poet, Ovid, stated: *"in medicine, as in life, until the mind has been prepared to see something, it will pass unnoticed as invisible, as though it did not exist."* (Binns 1973). We attempt to bring this body architecture, the self atmosphere, into existence, making it visible and challenging our perceptions. In doing so, we begin to colonize the gap between art and science.

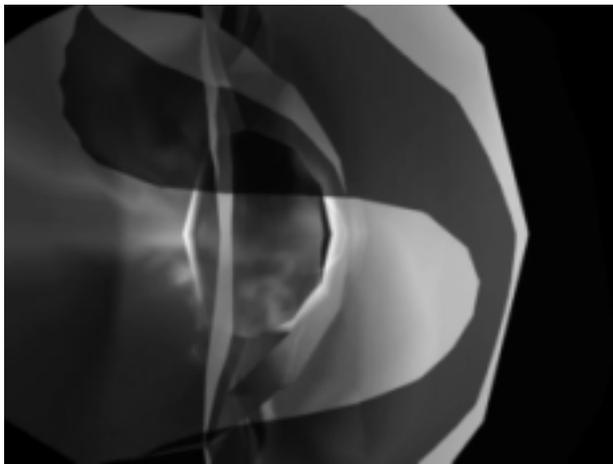
This project is still in an initial state requiring interdisciplinary research among architecture, psychology, computer science, and medicine. The challenge to date has not only been the interpretation of the physiologic data into corresponding aural representations, but also the utilization and design of software that takes on physiologic data and manifest it in a fluid audio-visual expression. Below are visual examples of our work as it stands today. Like Ovid's quotation, new visualization technologies lead to new understandings because they provide new ways of looking at the world. The invention and refinement of the microscope in the 1600's led to completely new understanding of life (Kittredge, 1990). Perhaps, this project will also lead to new understandings and advance our perceptions, not only of science and art but of our selves.



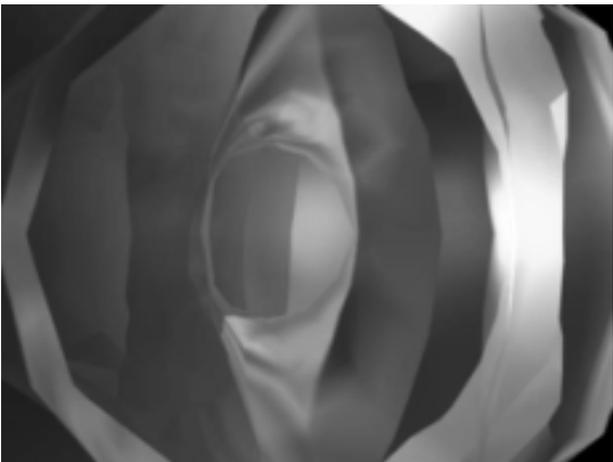
Near Critical Physiological Condition



Near Death Physiological Condition



Interior View of Normal Physiological Condition



Int. View of Near Critical Physiological Condition

References

- [1] Binns, J. (1973) *W. Ovid*. London, Boston: Routledge & K. Paul
- [2] Davis, E. (1996). "Osmose". *Wired* 4:8 (August), pp.137-140, 190-192
- [3] Diller, E. (1994). *Flesh. Architectural Probes*. New York: Princeton Architectural Press
- [4] Feher M. with R.Naddaff & N.Tazi (Eds.) (1989) *Fragments for a History of the Human Body (Part Two) — Zone 4*. New York: Urzone Inc.
- [5] Frank, K. (1995). "When I Enter Virtual Reality, What Body Will I leave Behind?" *A.D. Profile #118: Architects in Cyberspace*, pp.20-23
- [6] Kittredge, M (1990). *The Human Body: An Overview*. New York, NY: Chelsea House Publishers.
- [7] Novak, M. (1995b). "TransTerraFirma"; *Sites* Vol. 26, pp. 34-53
- (1995a). "Transmitting Architecture". *A.D. Profile #118: Architects in Cyberspace*, pp.42-47
- [8] Oki, K. (1995). "Brain Wave Rider: A Human-Machine Interface", *Leonardo*, Vol. 28, # 4, pp. 307-311
- [9] Scheidt, D. & R. Kyr (1994). "Extended Gamelan: An Interactive Virtual Music Environment"; performance piece done at the *Fourth International Conference on Cyberspace*. The Banff Centre. Banff, Canada (Collected Abstracts, p.22)
- [10] Schiphorst, T., S. Mah & J.Crawford (1994), "StillDancing: Interacting Inside the Dance", performance piece done at the *Fourth International Conference on Cyberspace*. The Banff Centre. Banff, Canada (Collected Abstracts, p.21)
- [11] Sennett, Richard (1994). *Flesh and Stone. The Body and the City in Western Civilization*. New York: W.W.Norton & Company
- [12] Stafford, B.M. (1991). *Body Criticism: Imaging the Unseen in Enlightenment Art and Medicine*. Cambridge, MA: MIT Press.
- [13] Sterlac (1995). "Towards The Post-Human. From Psycho-body to Cyber-system". *A.D. Profile #118: Architects in Cyberspace*, pp.90-96
- [14] Stone, A. (1991). "Will the Real Body Please Stand Up? Boundary Stories about Virtual Cultures", W.Benedikt (ed.): *Cyberspace, First Steps*. Cambridge, MA: The MIT Press. pp.81-118
- [15] Wentwick, C. (1971). *The Human Figure in Art from Prehistoric Times to the Present Day*. Wynnewood: Livington Publishing
- [16] World Architecture (1995). "Interactive Architecture". *World Architecture #39*, pp.146-151