

NEAR-LIVING ARCHITECTURE

WORK IN PROGRESS FROM
THE HYLOZOIC GROUND COLLABORATION

2011-2013

Edited by Philip Beesley

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CONTENTS

PHILIP BEESLEY

- 8 Introduction
- 35 Diffusive Prototyping

RACHEL ARMSTRONG

- 45 Potent Matter: The Dynamic Chemistries of Hylozoic Ground

DANA KULIĆ, ROB GORBET & ALI-AKBAR SAMADANI

- 63 Using Affect to Increase Empathy in Near-Living Architecture

CHRISTIAN DERIX, LUCY HELME & ÅSMUND IZAKI

- 73 Anticipating Behaviours

MICHAEL STACEY & CHANTELE NIBLOCK

- 85 Prototyping Protocell Mesh

BECKY CARROLL, ROB GORBET & LUCINDA PRESLEY

- 97 It Lives! Promoting Creative and Innovation Thinking in Education

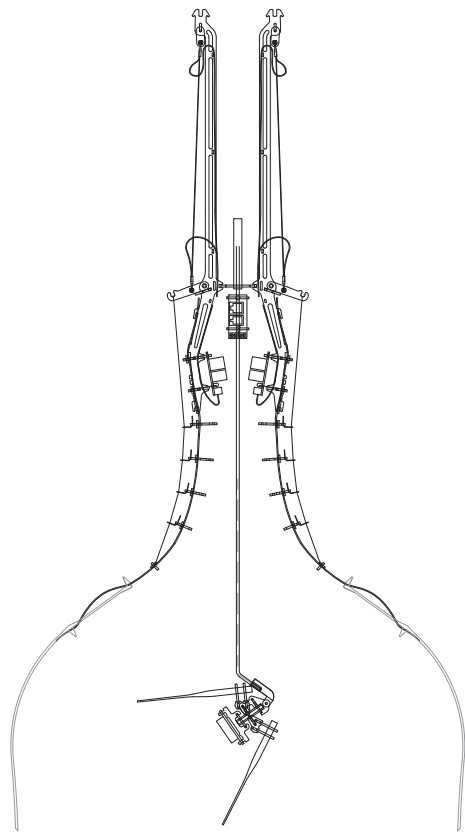
111 Hylozoic Series Projects 2011-2013

113 About the Hylozoic Ground Collaboration

113 Author Biographies

119 Installation Credits

124 Image Credits



Introduction

If architecture aspires at times to be a framing structure that comes between ourselves as human bodies incarnate and a wider universe, providing a way of establishing our place in that larger world, then it would seem appropriate that architects today begin to develop structures that articulate what we currently understand that universe to be. Hylozoic Ground is, beyond an exquisite moment of modern rococo, an attempt to construct such a veil of emplacement.

Aaron Betsky
Architect Magazine, 2010

Can architecture feel, and know, and respond to their occupants? Might buildings begin, in primitive ways, to come alive? The Hylozoic Series brings together researchers and industry collaborators from Canada, USA, and Europe in an interdisciplinary research cluster attempting to develop a potent new kind of architecture. The group is devoted to developing new technologies and new aesthetics for responsive, adaptive building systems. Building on early steps that have integrated lightweight digitally fabricated structures, interactive mechanisms and sensor networks within new building structures, the group is now developing functions that pursue empathic feelings and that contain self-renewing metabolisms. This book gathers together working papers for this increasingly ambitious collaboration.

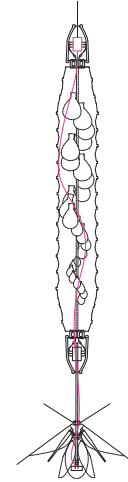
'Hylozoism' refers to the philosophy that all matter has life. The Hylozoic Series builds upon this ancient conception by designing synthetic organic environments. A new generation of interactive technologies is rapidly emerging within contemporary architecture. Machine learning, emotional computational systems and synthetic biology reactions are at the very early stages of integration within these systems. These environments raise fundamental questions: how might we visualize the dynamics of open, evolving systems? How might new models emulating living systems and ecologies be translated into effective tools for design? New kinds of language are needed that provide critical terms of reference for discussing precise qualities of complex systems. New

technical systems are needed that provide flexibility and resilience in handling conditions lying far from equilibrium. Accompanying this specialized language and technology, the group is developing new methods that can equip next generations of interdisciplinary researchers with effective design tools. Creative possibility is encouraged by following many cycles of simulation, testing and physical building.

The hybrid working methods demonstrated here involve many parallel cycles of conception, modeling, full-scale prototyping and performance analysis. The group combines both rigorous applied research and free-ranging speculation. Collaborators combine paradigms of organization and interaction that include diffusive form-language from industrial design, distributed networks and meshed arrays from mechatronics, and protocell chemical reaction design from synthetic biology. These conceptions are being used for the purpose of forming coherent, durable, functional public-scale architectural prototypes. Interdependence of specific systems and systems uncertainty characterize this pursuit.

EVOLVING CONCEPTIONS OF ARCHITECTURE

A new generation of interactive architecture is rapidly appearing. Surging critical interest is evident in kinetic and interactive projects this past decade, building on debates from 1960s cybernetic theory and exemplified by widely recognized built projects such as dECOi's "Aegis Hyposurface"². Rooted in technical innovations, these emerging projects often employ distributed communication and control systems, lightweight actuators and sensors integrated within component-based envelope systems.³ Supported by design methods involving cycles of dynamic visualization and simulation⁴, enhanced by new design tools employing generative and parametric software⁵, critical voices proclaim expanded qualities of a new 'instrumental' architecture validated under broadly-defined 'performance'.^{6,7} The qualities focused by voices such as Kolarevic⁹, McCullough¹⁰, Leach¹¹, and Spiller¹² imply an increasing consensus of key immanent, dynamic, and open qualities in this emerging work, following canonical sources on digital environments such as Negroponte's *Aspects of Living in an Architecture Machine*¹³ and *Being Digital*¹⁴, and McCullough's 1995 work, *Digital Ground*. This cluster of sources revolve around theories of interactional design that are marked by a striking optimism about the expanded powers of performance-based architecture.



1 Column from Aurora
Simons, Edminton 2012

2 Spiller, Neil, *Digital Architecture Now: A Global Survey of Emerging Talent*, Thames & Hudson, 2009.

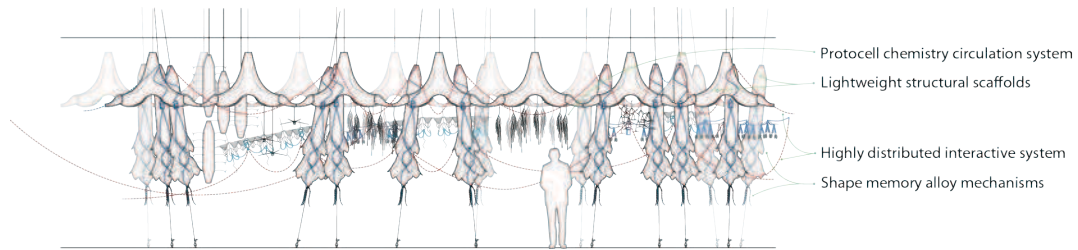
3 Fox, Michael; Kemp, Miles, *Interactive Architecture*, Princeton Architectural Press, 2009.

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8 Schematic organization of Hylozoic Ground, Venice Biennale for Architecture, 2010

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However, while Hylozoic Series research aligns with many aspects of this new performance based architecture, the contributions of the partnership also shows critical restraint. The critical issues raised by this progress merit considerable debate. New paradigms are implied where humanity is seen as a participant in the complex negotiations between nature, culture and technology,^{15,16} or as architectural theorist Detlef Mertins puts it "the tangled web of creatures and environments within which humanity lives a promiscuous life."¹⁷ In this reformed conception, humanity is entangled with natural and artificial processes by occupying a liminal rather than central position.

METHOD

Research is structured in five parallel streams:

- Meshwork and Component Design Systems
- Complex-Systems Simulation, Modeling and Interaction Design
- Living Chemistry Systems
- Cognitive and Brain Research
- Knowledge Integration and Pedagogy

Each of these stream move in multiple cycles through three phases:

- Development of tools and cross-disciplinary working methods.
- Material experimentation accompanied by built prototypes. Through this process, research is channeled into fabrication and accompanying issues of scale and material creation are addressed.
- Adaptation of prototypes into full-scale environments and observing public occupation. Cultural institutions are acting as collaborators presenting public exhibitions as test facilities that support ongoing study and development of this work.

INTRODUCTION

MESHWORK AND COMPONENT DESIGN SYSTEMS

Lightweight structures and component systems are organized in textile-based geometric systems employing massively repeating lightweight modular scaffold components. Collaborators draw upon crafts of digital prototyping, industrial design and multi-scaled architectural craft. The designs of these structures provide resiliency, durability, and capacity for kinetics. The research focuses on material, chemical and kinetic component integration.

COMPLEX-SYSTEMS SIMULATION, MODELING AND INTERACTION DESIGN

Partners with expertise in robotics, mechatronics, and digital visualization are developing responsive and empathic functions by developing performance and control systems, by modeling interaction between occupant and space to improve interaction design, and by developing design tools for visualizing and synthesizing interactive performance behaviours. Four parallel research clusters each carry responsibility for key systems:

1. Affective movement recognition/generation examines intelligent systems, applying the core question: can we generate devices and motion paths for affective communication in support of empathic relationships in near-living architecture?
2. Real-time algorithms for maximizing engagement: how might a near-living architecture learn from its interactions with occupants in order to maximize occupant engagement, and thus the effectiveness of the relationship, in real-time?
3. Electronic and mechanical design focuses on control of distributed arrays of actuators in layered heterogeneous technical systems employing massively distributed sound, light, kinetic, air and fluid systems actuation supported by arrayed sensor networks.
4. Development modeling and interaction design includes pattern analysis to understand correlations between occupant and space.

LIVING CHEMISTRY SYSTEMS

Protocell artificial biology systems show qualities of near-living systems composed from fluid-based inorganic chemistries. These systems are capable of processing gas and fluid-based environmental elements, and are at the early stages of integration within experimental architectural facades and canopies.

COGNITIVE AND BRAIN RESEARCH

Research in this stream explores the cognitive and emotional response of occupants in actuated environments, drawing from empathic systems developed in the Complex-Systems Simulation stream described earlier. The research in this stream expands upon movement study to explore the experience of occupants within interactive environments.

KNOWLEDGE INTEGRATION AND PEDAGOGY

Two parallel streams focus on curriculum development and interdisciplinary working methods. The first stream works with specialized curriculum to train students from kindergarten to grade 12 in critical thinking and innovation skills required to address complex problems. The research integrates current STEM education (Science, Technology, Engineering and Mathematics) with art creating hybrid STEAM (Science, Technology, Engineering, Art and Mathematics)-education models. In addition to developing critical thinking, group work, and design skills, the workshops reinforce connections with creativity and the arts. The second parallel stream is developing working methods for interdisciplinary research supporting collaborative process among partners.

IMPACT

New design paradigms offer diffusive form-languages and highly distributed and iterative prototype development. New generations of young students and professional designers can be equipped with concepts that can position them for responsible, creative participation in synthesis and stewardship of the built environment. The technologies being developed in this collaboration have applications in sustainable architecture. Contributing to critical discussion, this work pursues mutual relations between synthetic constructions and the natural world.

overleaf

- 1 Epiphyte Chamber, Seoul, 2013
- 2 Epiphyte Grove, Trondheim, 2012
- 3 Epiphyte Chamber, Seoul, 2013
- 4 Hylozoic Veil, Salt Lake City, 2011
- 5 Protocell Mesh, Nottingham, 2012
- 6 Epiphyte Chamber, Seoul, 2013
- 7 Epiphyte Grove, Trondheim, 2012
- 8 Epiphyte Grove, Trondheim, 2012
- 9 Epiphyte Spring, Hangzhou, 2013
- 10 Technical Drawings

INTRODUCTION

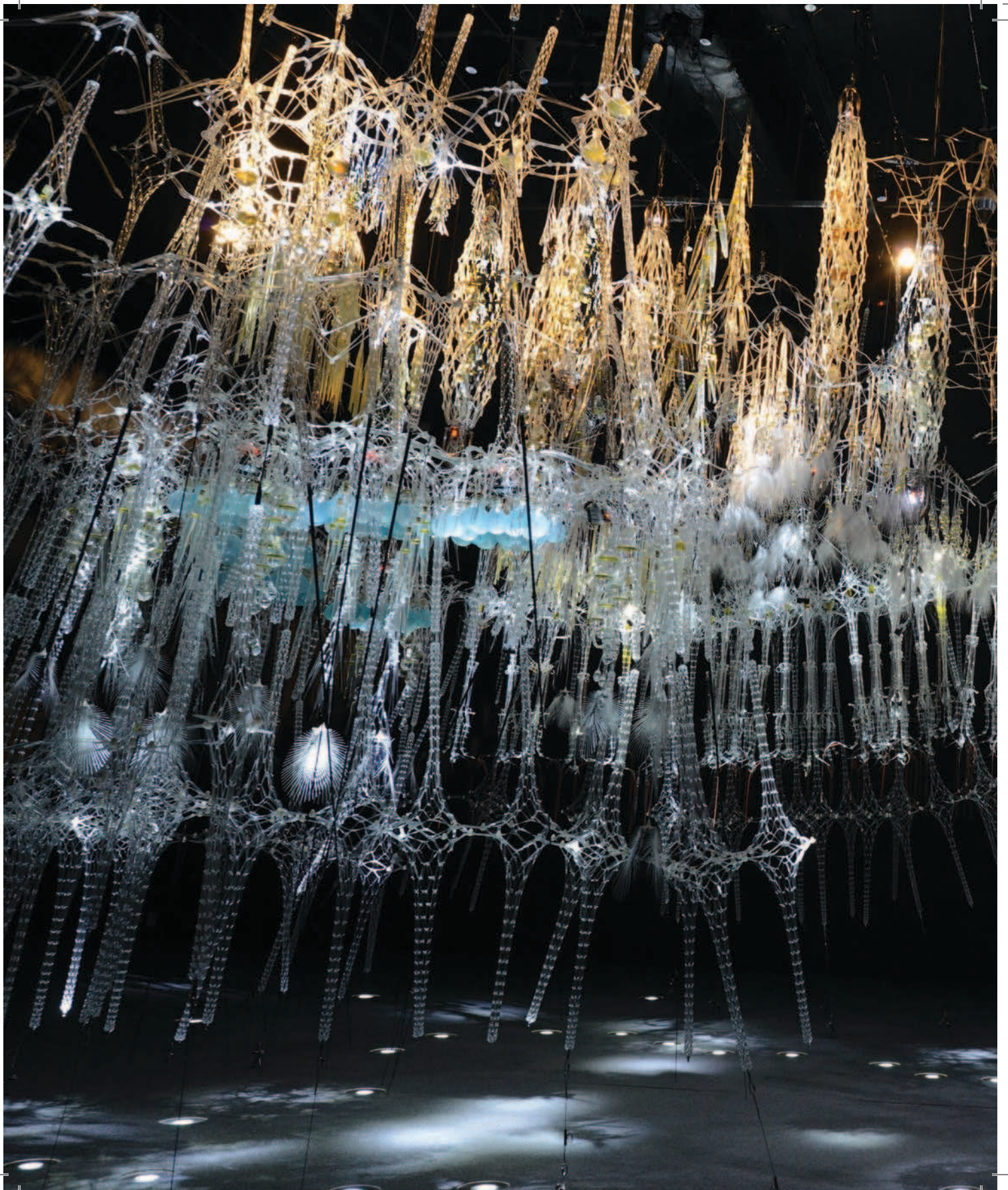




IMAGE CREDITS

DIFFUSIVE PROTOTYPING

Philip Beesley

USING AFFECT TO INCREASE EMPATHY IN NEAR-LIVING ARCHITECTURE

Ali-Akbar Samadani, Dana Kulic & Rob Gorbet

3. PBAI

7, 9, 12, 17. Dana Kulic and Rob Gorbet

ANTICIPATING BEHAVIOURS

Asmund Izaki, Christian Derix & Lucy Helme

2. PBAI

7-9. Aedas Computational Design & Research

EMPOWERED MATTER: THE DYNAMIC CHEMISTRIES OF HYLOZOIC GROUND

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2. PBAI

33. Simone Ferracina

IT LIVES! PROMOTING CREATIVE AND INNOVATION THINKING IN EDUCATION

Lucinda Presley, Becky Carroll & Rob Gorbet

7 & 19. PBAI

25-34, 36-38. It Lives!

PROTOTYPING PROTOCELL MESH

Michael Stacey & Chantelle Niblock

3, 11, 34. PBAI

8, 15. University of Nottingham

Near-Living Architecture

Work in Progress from the Hylozoic Ground Collaboration 2011-2013
Philip Beesley, editor

Can architecture integrate living functions? Can new buildings know and care? The Hylozoic Series brings together researchers and designers from Canada, USA, and Europe attempting to develop a potent new kind of lightweight architecture. The group is devoted to developing new technologies and new aesthetics for adaptive building systems. New generations of floating filigrees and filtering meshworks offer empathic feelings and self-renewing metabolisms. This book gathers together working papers that demonstrate current work in progress within this increasingly ambitious collaboration. Documents from Hylozoic Series installations in Salt Lake City, Sydney, Trondheim, Nottingham, London, Cambridge, Paris, Hangzhou and Seoul constructed between 2011 and 2013 are included in brief.

With contributions by

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Ali-Akbar Samadani
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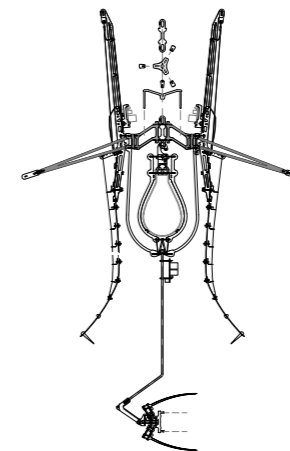
BEESLEY

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References

See references in text.