# ACADIA 2013
# ADAPTIVE ARCHITECTURE

Waterloo / Buffalo / Nottingham

Proceedings of the 33rd Annual Conference
of the Association for Computer Aided Design in Architecture

Edited by Philip Beesley, Omar Khan, Michael Stacey acadia

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# ACADIA 2013
# ADAPTIVE ARCHITECTURE

Proceedings of the 33rd Annual Conference of the
Association for Computer Aided Design in Architecture
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University of Waterloo
University at Buffalo, SUNY
University of Nottingham

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# ACADIA 2013
# ADAPTIVE ARCHITECTURE

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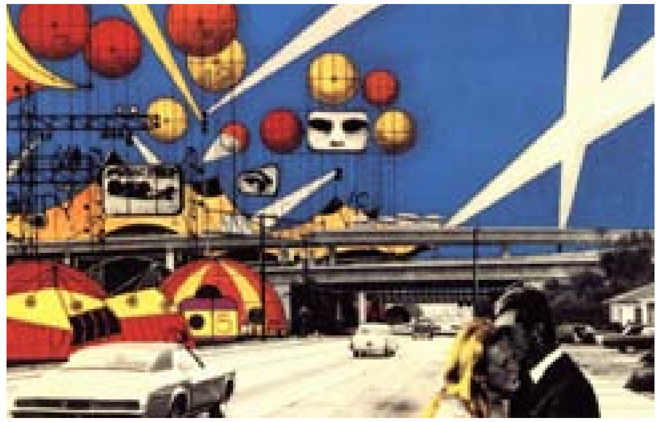
# INTRODUCTION

**Philip Beesley** University of Waterloo
**Omar Khan** University at Buffalo
**Michael Stacey** Univeristy of Nottingham

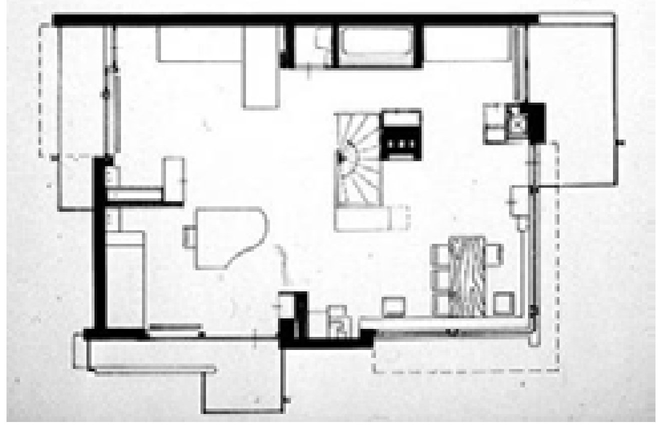
ACADIA 2013 Adaptive Architecture, the 33rd International Conference of the Association for Computer-Aided Design in Architecture, focuses on the computational design of environmentally responsive, intelligent, interactive, and reconfigurable architecture. Organising this conference we perceive new intellectual territories opening, arising both from technology and from our native inventiveness. In 2013, humankind benefits from millennia of cultural continuity while it faces profound challenges and opportunities. Fuelled by potent new research tools and techniques the discipline of architecture is ripe with potential. New modes of practice offer models where research, design and development are seen as one, and where knowledge passes with extraordinary fluidity, as if by osmosis, from practice to academia, from teacher to pupil and from the future architect to the architect-academic. The future is now.

Sir Peter Cook opened the first Adaptive Architecture Conference, at the Building Centre, London, on 3 March 2011. He addressed Adaptive Architecture with a body of work that included the inspirational teaching of over three generations of future architects. We have yet to see Archigram's visions fully realized, yet the pen-and-ink drawings by Cook and his collaborators present a future with such veracity that looking at them in a magazine or gallery one cannot help dreaming of a more flexible and adaptive future for architecture and humankind.

New roles for architectural environments are emerging that transform portions of static buildings into dynamic responsive surfaces by equipping them with near-living intelligent distributed computation systems and chemically active functions. Adaptation of architecture can be as simple as the windows, blinds and sliding screens of Gerrit Rietveld's Schroder House, 1924, where the first floor transforms from spaciousness to intimacy in the hands of its occupants, or it can be the sophisticated biomimetic gill-like adaptive shading of Ocean One by the Austrian practice of Soma.[i] New design methods and new qualitative and performance-based paradigms are needed for working with complex systems within the built environment. Adaptive architecture is as much about process as well as product and outcome. We could recall Cedric Price's prescient mantra from his 1976 Generator project: "never look empty, never feel full". This observation speaks to adaptation in architecture in a poignant way, addressing its unstable, liminal nature. Price envisioned an adaptive architecture perceived within dynamic, ever-changing space. Equally important would be its emotional effects on the inhabitants which he suggests could be felt in the lack: never empty, never full.



1 Instant City, Peter Cook/ Archigram,1969



2 First Floor of Gerrit Rietveld's Schroder House, 1924 - open

3 First Floor of Gerrit Rietveld's Schroder House, 1924 - cellular

Architecture has always been inventive and adaptable. Our current era, however, is unique in its technical potential and in the formidable challenges that societies and environments face today. The built environment is becoming responsive in terms of physical, real-time changes acting under intelligent controls. At the same time, the design of adaptive architecture might involve a dilemma that alternates between searching for materials and systems to be able to do so much more and perform so much better, while at the same time dwelling on substantial concerns about the potent implications of active, regenerative systems. What are the consequences of making adaptive architecture? How might we become responsible for this expansion of the power of architecture?

4 Dynamic Adaptive façade of Ocean One, SOMA

5 13 meter GFRP Prototype of gill like adaptive shading of Ocean One, SOMA

The papers included in ACADIA 2013 Adaptive Architecture provide a lens into the potential for architectural adaptation within our built environment. Recurring terms run throughout these papers, offering an emerging field of qualities: *self-assembling, irregular, performative, aggregate, genetic, stigmergic, generative, regenerative, morphogenetic, parametric, evolutionary, resilient, learning, morphing, behavioural, active, alloplastic, responsive, variable, reviving, deployable, differentiated, open-ended*. These qualities seem closely aligned with the attributes of living systems. Analogies drawn from life testify to inspiration for design, and they also imply aspirations to explicit performance, analysing and implementing tangible functions.

With the range of topics presented here, material intelligence appears as one consistent focus. Here emphasis on material properties and intelligent assemblies provides opportunities for designers to explore multiple scales and exploit new optimizations. Structures that are open to environmental and climatic influence to elicit change are one of many goals of this work. Another area of interest is in the adaptive nature of energy. Banham and Dallegret's Environment Bubble has burst and energy no longer requires membranes to control it. Like materials its instability is welcomed yet made more predictable through complex feedback systems and visualization. A more precise understanding of how energy works in buildings suggests a different model of energy performance that is no longer thermostatic but thermomorphic and evolutionary.

The embedding of information systems in architecture to make them interactive and responsive is another recurring area of research. Kinetics remains a strong interest within this topic including work on moving structures, shape memory alloys and new tectonic assemblies. A rapidly-growing interest in intelligent robotics is evident, from swarming capacities to remote action through geospatial controls. As responsive systems are realized, opportunities for social action through these responsive environments has also become an important issue.

Finally, we are seeing continued shift towards performance-based issues in modelling, visualization and fabrication. Through advanced computational tools the focus has moved from how something looks to how it behaves. Performativity has introduced a new attitude that is ripe with optimism. New mechanism for evaluating and simulating architecture that can respond to real time data is calling into question basic tenets of practice. There is caution to be had here as we embrace new opportunities. The spectre of technological determinism indeed lurks here, undermining the "lack" that Price so astutely observed as a quality to strive for.

Adaptive qualities offer the means to realise a myriad of opportunities within contemporary architecture and they can be used to address key challenges facing humankind, including global warming. In the twenty first century we have the knowledge and technology to pursue sensitive, renewed relationships for humankind interconnected with their surrounding environment.

NOTES

[i] soma - http://www.soma-architecture.com. The 13 meter high GFRP prototyping of this adaptive facade is included in Prototyping Architecture – the exhibition that accompanies ACADIA 2013.

[ii] Kristina Schinegger & Stefan Rutzinger, Adaptive Formations: Two Pavilions, One Adaptation and One Tower in Michael Stacey, ed., Prototyping Architecture, Riverside Architectural Press, 2013, p. X

[iii] ibid

# IMAGE CREDITS

## MATERIALS

### Responsive Expansion

*Sixto Cordero, Austin Smith*

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2 Cordero, Smith. 2013. Swelling rate relative to grain direction.
3 Reeb, James Edmund. 1995. Wood cell composition, displaying elongated axis.
4 ———. Variations of warping as dependent of grain.
5-17 Cordero, Smith. 2013. Active versus static state
18 Cordero, Sixto; Smith, Austin. 2013. Adaptive.
19 ———. Discretization iterations and process of transformation from static to active.

### Hygroskin

A Climate-Responsive Prototype Project Based on the Elastic and Hygroscopic Properties of Wood

*David Correa, Oliver David Krieg, Achim Menges, Steffen Reichert, Katja Rinderspacher*

1a-b Institute for Computational Design. 2013. HygroSkin Pavilion. .
2a-b Institute for Computational Design. 2013. Hygroscopic Apertures.
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3b Schleicher, Simon; Menges, Achim. 2010. ICD/ITKE Research Pavilion.
4 Institute for Computational Design. 2013. Cone Geometries.
5a-b Institute for Computational Design. 2013. Hygroscope.
6a-7b ———. HygroSkin Pavilion.
8a-b ———. Fabrication Process.
9 ———. Module assembly on a mold.
10a-b ———. General Machine Setup.
11 ———. Connection Details.
12 ———. HygroSkin Pavilion.

### Working with Multi-scale Material Distributions

*Panagiotis Michalatos, Andrew Payne*

1a Michalatos, Panagiotis; Payne, Andrew. 2013. Femur bone representations - surface model.
1b Dilman, Nevit. 2011. Femur bone representations - X-ray.
1c Wolff. 2010. Femur bone representations - principal stresses.
1d Gray's Anatomy. 1918. Femur bone representations - section.
1e Gtirouflet. 2012. Femur bone representations - trabecular microstructure.
2 Michalatos, Panagiotis; Payne, Andrew. 2013.Two dimensional halftone patterns.
3 ———. Minimum compliance fuzzy reinforcement, model and prototype.
4 ———. Distance field based modeling.
5 ———. Three-dimensional multimaterial rasterization software screenshots. dimensional halftone patterns.
6 Nichols, Nancy. 2013. Macroscopic gyroid density variation materialized by a microscopic gyroid based raster pattern.
7 Michalatos, Panagiotis; Payne, Andrew. 2013.Blending in voxel based modeling.
8 ———. A screenshot of the interface showing the blending of the density field around two curve objects and a linear material gradient.
9 ———. Light transmittance can be controlled through the tilt angle of the 3D printed panel.
10 ———. Designed multi-material patterns as seen under a microscope.
11 Seyl, Drew;  Ugarte, Juan Pablo. 2013. Student projects demonstrating anisotropic opacity and controlled light propagation.
12 Michalatos, Panagiotis; Payne, Andrew. 2013. Anisotropic elasticity in 3d printed material sheet.

### Adaptive Morphologies

Toward a Morphogenesis of Material Construction

*Carolina Ramirez-Figueroa, Martyn Dade-Robertson, Luis Hernan*

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2 ———. SynthMorph attractors.
3 ———. Graphical interface.
4 ———. AT1-A series.
5 ———. T3-C series.
6 ———. Particle distribution in ATF-A.
7 ———. Particle distribution in ATF-C.
8 ———. Cell densities artifacts.
9 ———. Patterns in material disposition.
10 ———. Physicochemical interactions.
11 ———. Particle distribution.
12 ———. SynthMorph particles.
13 ———. Multiple particle system.
14 ———. Cell cluster density.

### Material Parameters and Digitally Informed Fabrication of Textured Metals

Material Parameters and Digitally Informed Fabrication of Textured Metals

*Christopher Romano and Nicholas Bruscia*

1 Bruscia, Nicholas; Romano, Christopher. 2013.  project 2XmT. Buffalo, NY: Under Construction.

## ENERGY

### Understanding Heat Transfer Performance for Designing Better Facades

*Jane Burry, Flora Salim, Alex Pena de Leon, Kamil Sharaidin, Mani Williams, Stig Nielsen, Mark Burry*

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2 Chen, CanHui. 2013.  Box construction details and façade attachment options. Melbourne.
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4-5 Williams, Mani. 2013. Thermal sensors used.
6 Pena de Leon, Alex. 2013. Digital Workflow.
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8 Dino, Ipek Gurse. 2013. Digital simulation workflow.
9 ———. Physical prototypes for analog simulation.
10 ———. Analog simulation results visualized.
11 ———. Thermal camera images.
12 Urquiza Sanchez, Rafael. 2013. Undulating cellular network system.
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14 Shahi, Sheida. 2013. Star-based folding structure design.

### Designing In Performance

A Case Study of Applying Evolutionary Energy Performance Feedback for Design

*David Gerber, Shih-Hsin Eve Lin, Xinyue Ma*

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2 Gerber, David; Lin, Shih-Hsin Eve; Ma, Xinyue. 2013. Pre-parameterization design process.
3 ———. Parametric design of the case study.
4 ———. 2013. Digital simulation workflow.
5 ———. Physical prototypes for analog simulation.

### Visualization of Building Energy Performance in Building Information Models

*Woonseong Jeong, Jong Bum Kim, Mark Clayton, Jeff Haberl, Wei Yan*

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2 ———. SynthMorph attractors.
3 ———. Graphical interface.
4 ———. AT1-A series.
5 ———. T3-C series.
6 ———. Particle distribution in ATF-A.
7 ———. Particle distribution in ATF-C.
8 ———. Cell densities artifacts.
9 ———. Patterns in material disposition.
10 ———. Physicochemical interactions.
11 ———. Particle distribution.
12 ———. SynthMorph particles.
13 ———. Multiple particle system.
14 ———. Cell cluster density.

### Integrative Computational Design

*Carolina Ramirez-Figueroa, Martyn Dade-Robertson, Luis Hernan*

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2-3 ———. EPI parameter creation to communicate BEP results in Revit.
4 ———. Visibility setting to create color-coded building components.
5 ———. Object-based BES results from OOPM.
6 ———. Workflow of BEPV using Autodesk Revit and its API.

### Wiring to the Sky

*Kyle Konis*

1 Konis, Kyle. 2013. Chrome sphere used to create spherical light source.
2 ———. 180-degree fish-eye lens used to create hemispherical light source.
3 ———. Rendering of a virtual object by four distinctly different physical light sources.
4 ———. Process for physical sky-sensing, analysis, and control of virtual object.
5 ———. Transient sky luminance, one image / three min. (8:00 – 18:00), 10/19/2011.
6 ———. Dynamic shading device response to threshold changes in sky luminance.

### Towards BIM-based Parametric Building Energy Performance Optimization

*Mohammad Rahmani Asl, Saied Zarrinmehr, Wei Yan*

1 Rahmani Asl, Mohammad; Zarrinmehr, Saeid; Yan, Wei. 2013. BIM-based Parametric Energy Optimization-Revit2GBSOpt.
2 ———. The BIM model of the case study with different window sizes that can be parametrically changed by Revit2GBSOpt.
3 ———. Building zoning (Left) and building analytical surfaces-gbXML.
4 ———. Parametric optimization of windows sizes to get LEED credit and minimized energy use.

### Adaptation as a Framework for Reconsidering High Performance Residential Design

A Case Study

*Geoffrey Thun, Kathy Velikov*

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2 ———. 2010. Exploded axonometric of North House building components.
3 Boake, Terri. 2009. Detail of BIPV fascia at southeast corner with exterior shades open.
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5 ———. Modified ESP-r model of annual heating and cooling loads: no shading (left), dynamic shading (right).
6 ———. Predicted demand reduction effects of DReSS design strategies on annual space conditioning load.
7 ———. Exterior shade configuration scenarios that formed the operational logistics framework for the home automation system.
8 ———, 2009. Iterative development and final configuration (right) of mullion cap and space for high-performance glazing system.
9 ———, 2010. Overview control architecture of CHAS, ALIS, and their integration with DReSS and mechanical sub-systems.
10 ———. Solar assisted heat pump system: cooling / dhw mode (left), heating/ dhw mode (right).
11 ———. Logic diagram for external shade and HVAC state control.
12 ———. ALIS components: an integrated suite of building-integrated and mobile interfaces.
13 ———. ALIS Home Touchscreen and shade control user override feedback (upper); ALIS GUI Web displays (lower).

## INTERACTIVE

### Morphological Behavior of Shape Memory Polymers Towards a Deployable, Adaptive Architecture

*Steven Beites*

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7 ———. Activating the SMP (steps one to three).
8.1 ———. Expansion sequence: (a) memorized shape, (b) temporary shape, (c) returns to memorized shape.
8.2 ———.Expansion sequence of the SMP when heated for shape recovery (386 seconds).
9.1 ———.Contraction sequence: (a) memorized shape, (b) temporary shape, (c) returns to memorized shape.
9.2 ———. Contraction sequence of the SMP when heated for shape recovery (434 seconds).
10 ———. SolidWorks™ animation sequence exploring the kinetic properties of folded patterns.
11 ———. Interconnected panel with snap-fit design application.
12 ———. Dynamic actuator in memorized "closed" shape.
13 ———. Dynamic actuator and interconnected panel.
14 ———. Final deployed condition upon successful activation of the SMP.
15 ———. Development of aluminum molds: (a) panel (b) dynamic actuator.
16 ———. Dynamic actuator—memorized "closed" state.
17 ———. Polypropylene (PP) injection-molded panel.
18 ———. Polypropylene (PP) panel and SMP actuator in memorized position.
19.1 ———. Shape recovery: (a) memorized shape, (b) temporary shape, (c) returns to memorized shape.
19.2 ———. Upon heating, the SMP actuator returns to its memorized shape (shape recovery) forcing the panels into a closed configuration (734 seconds).
20 ———. Closed assembly (actuator in memorized "closed" state).
21 ———. Open assembly (actuator in temporary state).
22 ———. Thermal image of the SMP during its solid state.

## Alloplastic Architecture

The Design of an Interactive Tensegrity Structure

*Behnaz Farahi Bouzanjani, Neil Leach, Alvin Huang, Michael Fox*

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## Resinance

A (Smart) Material Ecology

*Manuel Kretzer, Jessica In, Joel Letkemann Tomasz Jaskiewicz*

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## Robot Cowboy

Reviving Tundra Grassland Through Robotic Herding

*Ian Miller and Matt Rossbach*

1 Miller, Rossbach. 2013. Algorithmic Ecology System Diagram.

## Autonomous and Adaptive Cross Scalar Structures and Systems

*Maj Plemenitas*

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# INFORMATION

## Performative Surfaces

Making Adaptive Tools to design Roofs and Landscapes based on Computational Interpretation of Flow Patterns

*Masoud Akbarzadeh*

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3 ———. Contour manipulations: a. elements and intervals; b. plan; and c. surface result.
4 ———. DEM representation: a. pixels; b. image representation of a surface; c. surface result.
5 ———. Triangulated surface: a. Vertices and their connectivity; b. plan; and c. surface representation.
6 ———.a. Slope and contour lines; b. ridge and coarse lines; c. drainage paths; and d. plan view of the paths.
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11 ———. Surface with its surface network graph.
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13 Akbarzadeh, Masoud. 2012. Subdivision of the graph into three main parts: upper, middle and lower parts.
14 ———. a. Top, middle, and bottom part of the graph; and b. adding all parts together.
15 ———. Topologically similar network.
16 ———. a. Simple surface network module; b. aggregation; c. contour extraction; and d. final topography.
17 ———. a. Contour extractions and smoothening; b. smoothening level I; c. level II; and d. level III.
18 ———. a. Side by side aggregation of the Surface network units; and b. descending aggregation of the surface networks.
19 ———. Step by step transformation algorithm.
20 ———. Surface transformations algorithm.
21 ———. completion process; a. propagation process; b. cell activation process; and c. transformation process.
22 ———.Physical manifest of the process.
23-24 ———. Step by step process of activation of cells.
25 ———. Surface transformation algorithm II.
26 ———. a. Algorithm II; b. algorithm I.
27 ———. a. Point grid; and b. input Flow pattern on the point grid.
28 ———. a. Point grid; and b. input Flow pattern on the point grid.
29 ———. Each cell is compared to eight primary directions of the flow to rationalize the unitized direction vector.
30 ———. a. the area covered by downward only; b. covered by both; and c. covered with either/ or.
31 ———. a. Rationalized connected network; and b. shortest distance drawn from each point.
32 ———. Slope-finder algorithm; a. upward direction; b. downward direction; c. superimposition; and d. surface network graph.
33 ———. Physical model of the rationalized surface based on flow direction.
34 ———. Physical model of the discrete flow pattern for another surface geometry.
35 ———. a. Area of influence; b. input polyline; c. distance from point grid; and d. distance translation to height; e. transformed point.
36-37 ———. Different quantity of z creates different slopes for the surfaces.
38 ———. Spatial polyline generation: a. polyline; b. curve; and c. branching polylines and control polylines; d. branching sequence.
39 ———. Break in the geometry resulted from direct translation in plan and height caused by spatial curve.
40a-b ———. Point grid pre-transformation based on the spatial curves.
41 ———. Superimposition of linear height change and re-transformation of point grid due to spatial curve.
42 ———. Design Sample Using branching polylines.
43 ———. Design sample using only plan drawings of curves (designed by Joel Lamere)
44 ———. Linear versus non-linear transformation of point into 3D space.
45a-c ———. Use of non-linear transformation in generating surface geometry.

## Manufacturing Method

*Mark Ericson*

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## An Adaptive Architecture for Refugee Urbanism

Sensing, Play, and Immigration Policy

*Jordan Geiger*

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## Hackitecture

Open source ecology in architecture

*Akshay Goyal*

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## Programming in the Model

A new scripting interface for parametric CAD systems

*Maryam Maleki, Robert Woodbury*

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2 ———. PIM's goal is to break down the learning step between modeling and scripting to create a gentle slope system

## Stigmergic Space

Sensing, Play, and Immigration Policy

*Annalisa Meyboom, Dave Reeves*

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2 ———. Wasp nest construction process.
3 ———. Ant colonies construction process.
4 ———. Color space pheromone targets.
5 ———. Algorithm in process where two distinct families of agents negotiate spatial territories.
6 ———. Nodes.
7 ———. Nodes become pheremone sources.
8 ———. Nodes become pheromone sources to create templates representing external influences.
9 ———. Queen pheremone template representing public and private affects the program distribution.
10 ———. Examples of how node masking could be used.
11 ———. Pheromone values for programs.
12 ———. Pheromone values for programs with agent's desired number of nodes.
13 ———. External influences for scenario A representing exposure to light.
14 ———. External influences for scenario B representing a privacy gradient.
15 ———. External influences for scenario C representing privacy and circulation.
16 ———. Play out of stigmergic space application on scenario C.
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*Jose Sanchez*

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# ROBOTICS, MACHINING AND MECHANISMS

## Adaptable Communication Protocols for Robotic Building Systems

*Ubaldo Arenas Alvarez Del Castillo, Jose Manuel Falcon Meraz*

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## Responsive Materiality for Morphing Architectural Skins

*Chin Koi Khoo, Flora Salim*

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Preliminary Research and Taxonomy Towards an Ultra-Light Weight Architecture of Differentiated Components

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Simulation Models for Synthetic Non-convex Granulates

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### The Novel Stones Of Venice

Implementation of the Marching Cube Algorithm Towards an Open-Ended Strategy for Managing Mass-customisation

*Iain Maxwell, David Pigram, Wes Mcgee*

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*Ryan Mehanna*

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*Felix Raspall, Matias Imbern, Will Choi*

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*Matthias Rippmann, Philippe Block*

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Generative Fabrication and the Pliability of Form

*Jenny Sabin*

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### REHEARSAL

Investigating collaborative practice through design and performance processes; latest work in progress on the PERFORM project.

*Bob Sheil*

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2-3 ———. The Crying Room.
4 ———. Performed to a prepared script, a group of figures circle the scanner in a slow march whilst two individuals act out a spatial, temporal and audible performance.
5 ———. The image illustrates the degree of detail and information that is retrievable and capable of cross reference to performance scripts.
6 ———. This series of images (16-18), relay how the assembled digital model allows multiple roles to be performed by individuals.
7-8 ———. Enactment of forensic scene by "RCSSD CSI Group".
9 ———. Practice Room A. One of three sites selected to receive a paired instrument for PerFORM/The Scan Acts 2 & 3.
10 ———. Robotic arm is fitted with a reflective panel and sent a command to sweep in an arc whilst the event is scanned.
11 ———. Test illustrating the potential to synchronise reflective panel movement with scanner speed.
12 ———. Results of the Digital Realisation Test, closer view.
13 ———. Screengrab of grasshopper script at work on a 3D model generated by the site scan in Practice Room A, one of the selected site for Acts 2 & 3.
14 ———. Screengrab, alternate view.

### Hierarchy in Knitted Forms

Environmentally Responsive Textiles for Architecture

*Jane Scott*

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### Topology Optimization and Digital Assembly of Advanced Space-frame Structures

*Asbjørn Søndergaard, Oded Amir, Michael Knauss*

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Toward a Morphogenesis of Material Construction

*Martin Tamke, David Stasiuk, Mette Ramsgaard Thomsen*

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## DESIGN POSTERS

### Re-Folding Muqarnas

A Case Study

*Ghazal Abbasy-Asbagh*

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### Rapid Type Coffee Pod

*Kory Bieg*

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### Aqua Lung

*David Kim, Christopher Pela*

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### Sheltering The Permeable Body

*Brigitte Luzar*

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### Food Urbanism Scenario Modeling

*Trevor Patt*

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### Formicis

A Study in Behavioral Componentry

*Michael Rogers*

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### Bloom The Game

*Jose Sanchez, Alisa Andrasek*

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### Metabolic Change

Parametric Projections for Urban Configurations and Material Flow

*Matthew Seibert*

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### dFORM

Digital Fabrication of Responsive Materials

*Ming Tang*

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### Memory Cloud

*Andrew Vrana, Joe Meppelink*

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## RESEARCH POSTERS

### The Interplay of Fact and Fiction

Capitalizing on Serendipity in Digital Design Processes

*Trevor Patt*

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### Towards An Evolutionary System for Mass-Customization Under Prescriptive Design Environments

*Victor Bunster*

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### Crease, Fold, Pour

Revisiting Flexible Formwork with Origami Folding and Digital Fabrication

*Maciej Kaczynski*

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### Self-Organizing Origami Structures

*Dave Lee*

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### SAMBÓ

*David Kim, Christopher Pela*

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### Sensual Embodiment, or When Morphological Computation Shapes Domestic Objects

*Carol Moukheiber*

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### Agent Based Model for the Development of Integrative Design Tools

*Stefana Parascho, Marco Baur, Ehsan Baharlou, Jan Knippers, Achim Menges*

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### Agile Spaces

*Vera Parlac*

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### Building Bytes

3D Printed Bricks

*Brian Peters, Daphne Firos*

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### The Nuit Blanche Pavilion

Using The Elastic Behavior of Elastomers for A Lightweight Structure

*Gernot Riether, Keyan Rahimzadeh*

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### Kinetic Architecture Matrix

*Ruth Ron, Renate Weissenböck, Tzach Harari*

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*Andrea Rossi, Lila Panahikazemi*

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3 ———. Composition of the Block Simulation. output components, Dessau.

### Involute: A Method for the Integration of Multi-Axis Fabrication with a Helical System of Variable Wood Bending Without Molds

*Bennett Scorcia, Susan Lin.*

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### Tissue Architecture

Programmable Folding in Digital Responsive Skins

*Jae-Won Shin, Jenny E. Sabin.*

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### Off-Road City

*Michael Silver*

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### Constructing Morphogenetic Operators With Inversive Geometry

*Wesley Smith, Pablo Colapinto*

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### Cast Thicket

*Ken Tracy, Christine Yogiaman*

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### Curved Folding

Design to Fabrication process of RoboFold

*Sushant Verma, Gregory Epps*

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*Mark Weston*

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Lorem ipsum dolor sit amet, consectetur adipiscing elit. Ut at massa et felis suscipit molestie sit amet et quam. Aliquam velit mauris, varius nec porta et, iaculis non lectus. Morbi viverra tellus in libero malesuada ut malesuada tortor pretium. Suspendisse sodales tincidunt est, vitae porttitor est fringilla eu. Nunc eget molestie ante. In porttitor dapibus pulvinar. Vestibulum in tortor adipiscing ante bibendum auctor. Aliquam purus ipsum, faucibus a pulvinar a, ullamcorper id nulla.

Aliquam in cursus odio. Pellentesque convallis pulvinar orci eget tincidunt. Praesent sollicitudin condimentum dapibus. In non felis tortor. Integer felis lectus, ultrices ac ornare nec, mattis a lacus. In fermentum imperdiet ultricies.

Phasellus felis lacus, tempus ac consequat a, vestibulum et neque. Aenean ornare ultrices risus, at vestibulum libero pretium non. Duis vulputate interdum ante, pretium suscipit nisl ultricies et. Vivamus quam dui, convallis vel tristique sit amet, accumsan eget nibh.

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