

one minute madness



Challenges in Modular Spatial Robots

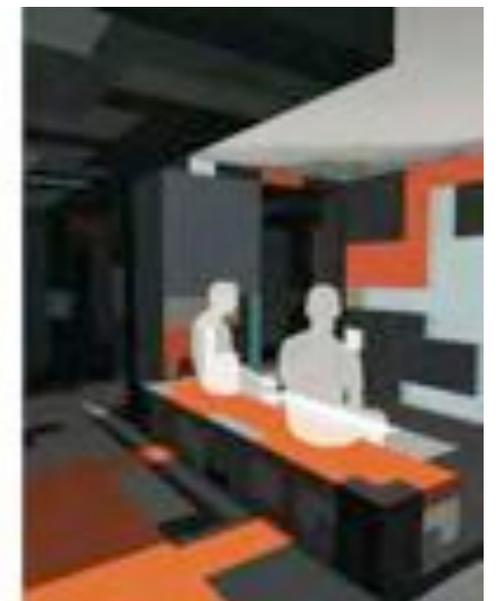
Miles Robert Kemp

Variate Labs, Spatial Robots, Los Angeles

Nano Meta-morphic Architecture

Small-scale self-similar robotic modules, kits easily transported to a site.

Each module has a different material on its exterior, hardware (sensors, accelerometers and kinetic parts) and logic to interpret and physically respond to different local and global inputs.





Modules move and attach to other modules to create specific configurations in real-time

Inhabitants use hundreds of thousands of these modules to create and recreate dynamic real-time formations optimized to specific activities and tasks.

Seven Challenges:

- Fail-safe systems maintain structural capabilities without power.
- Integrate modules with external landscapes and other objects.
- Control appropriate at specific scales.
- Multiple interaction scales balance local / global control.
- Build & enable movement of small-scale modules.
- Integrate information display.
- Design from users' perspective: identify and understand goals.



The End of Robotics in Architecture (as we almost got to know it)

Michael Fox
Cal Poly Pomona

The beginning of a paradigm shift from mechanical to biological in architecture: the end of robotics.

Decentralization

Modular Reconfigurable Robotics

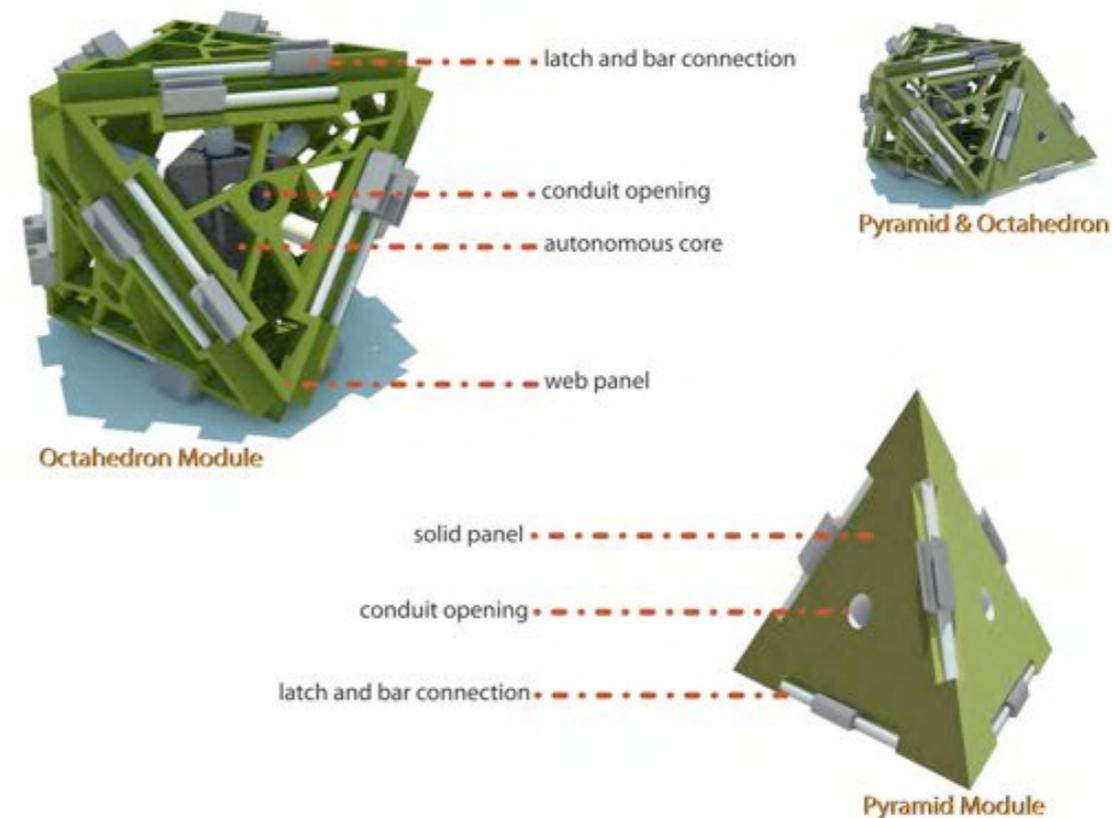
Architectural Space-Making

Prototyping at Human Scale

Biomimetics



The intent of architectural explorations in modular robotics is to design and evaluate the system with the potential to build them into systems that make up dynamic architectural space

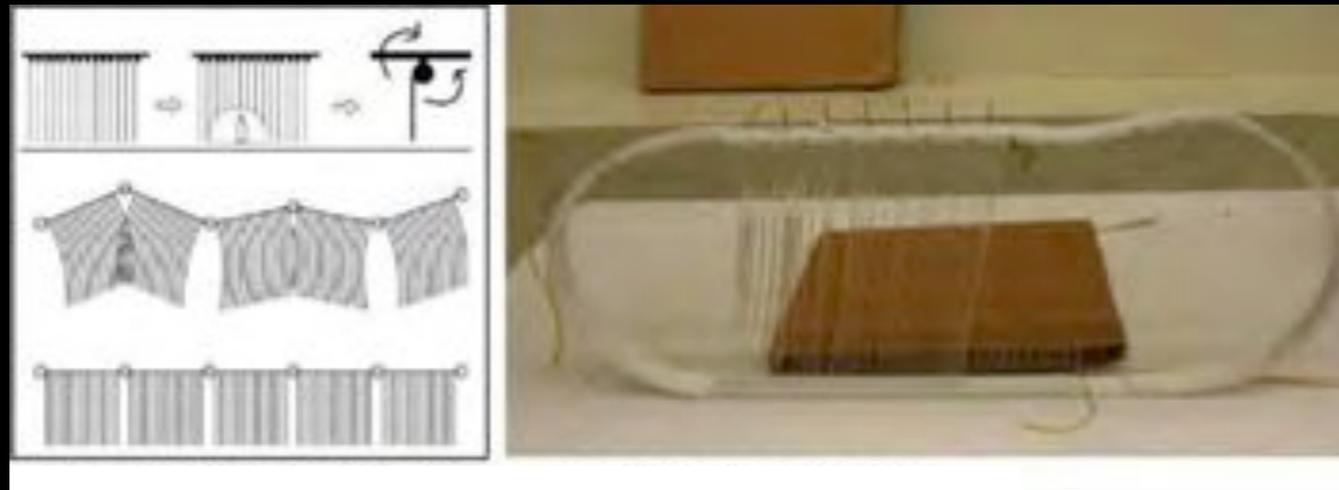


Technological advancements will expand robotics, and influence the scale by which we understand and construct our world, reinterpreting the mechanical paradigm of adaptation.

Re-examine and adjust scale of interactive materials. As physical robotic parts scale down, future systems built with nano- and bionanotechnology.

Unprecedented customization and reconfigurability and repositions the designer.

Pask: "The role of the architect here ... is not so much to design a building or city as to catalyze them: to act that they may evolve."

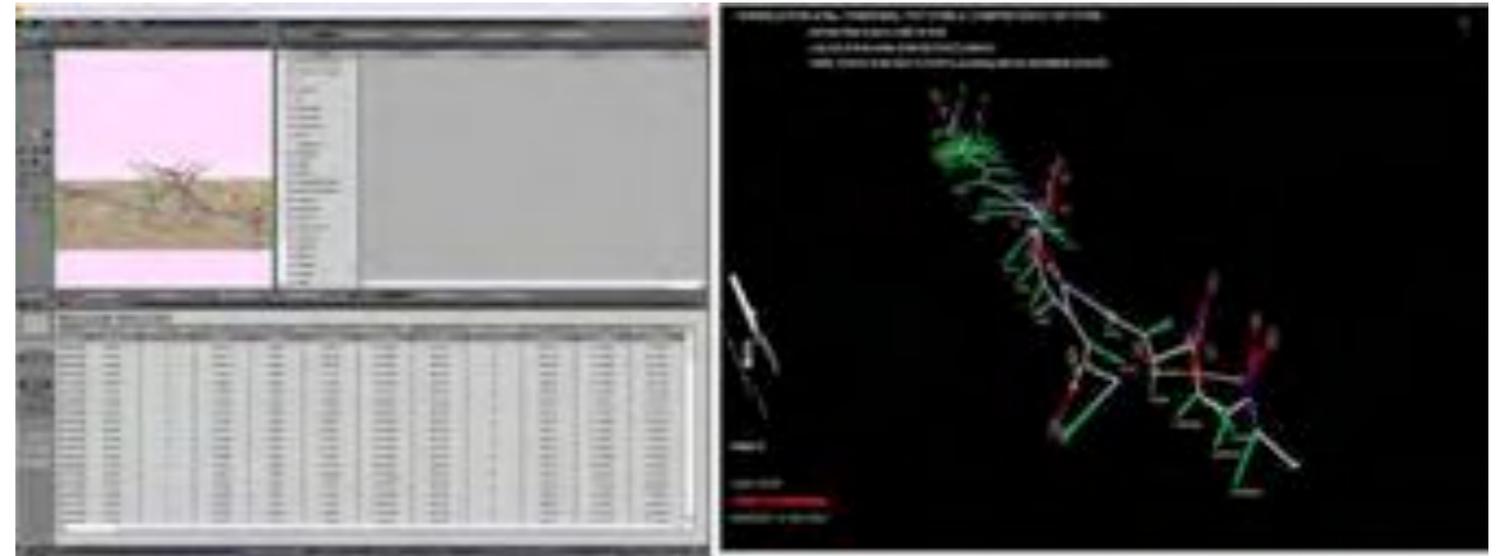


Prototypes for Non-standard and Interactive Architecture

Henriette H. Bier

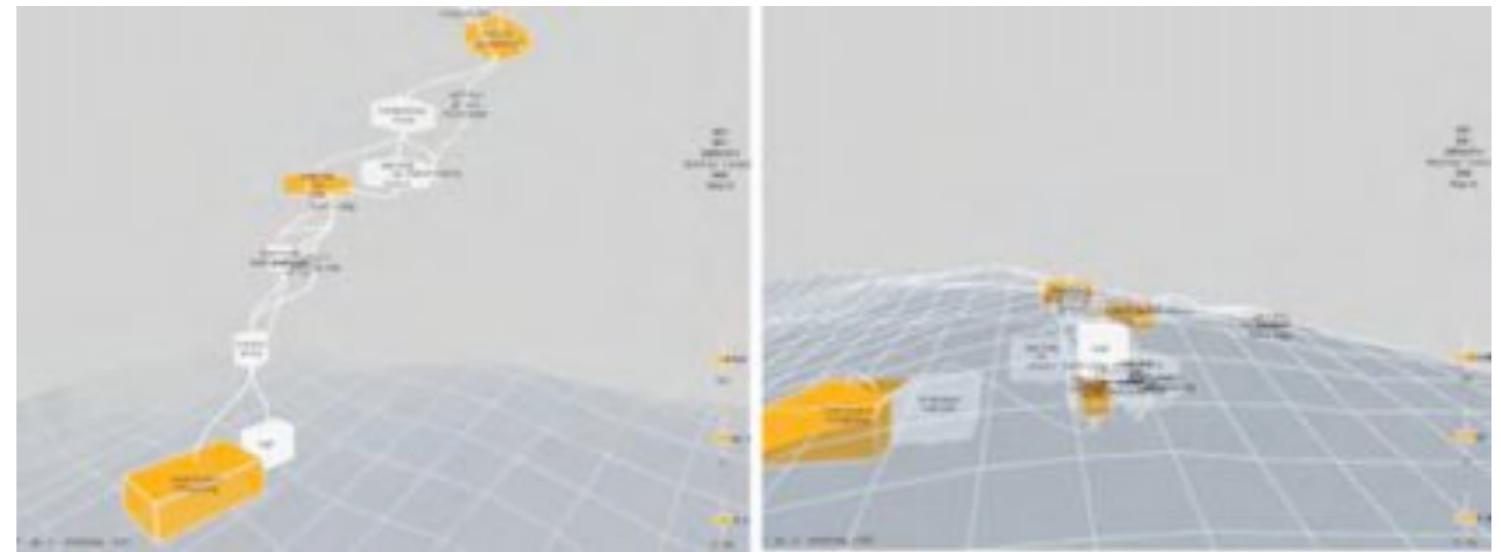
Hyperbody Research Group, TU/Delft

Emergent, bottom-up design processes (swarms, cellular automata, and genetic algorithms) replace the architect's exclusive control.



agents interact as birds in a flock

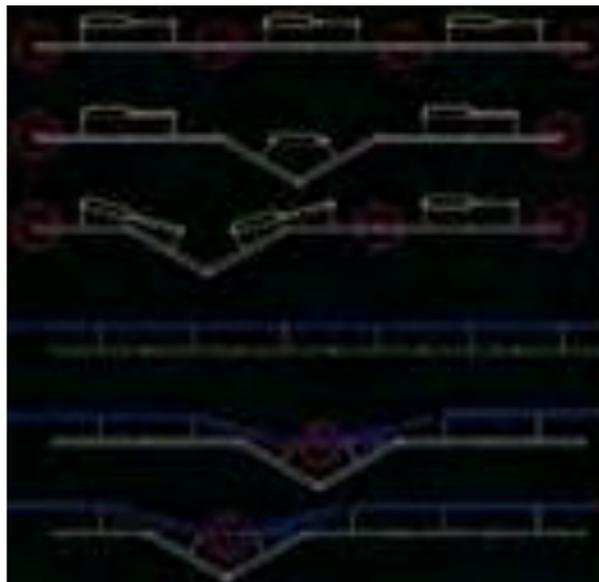
self-organization — soft- and hardware in robotic architecture.



particle spring: spatial allocation

‘wall’ senses when approached, creates opening

Building components respond to external inputs using sensor-actuator technologies to interact with users and surroundings in a self-organized manner.



New materials, construction methods allow architectural spaces to change geometry, freeing architecture from typological constraints.

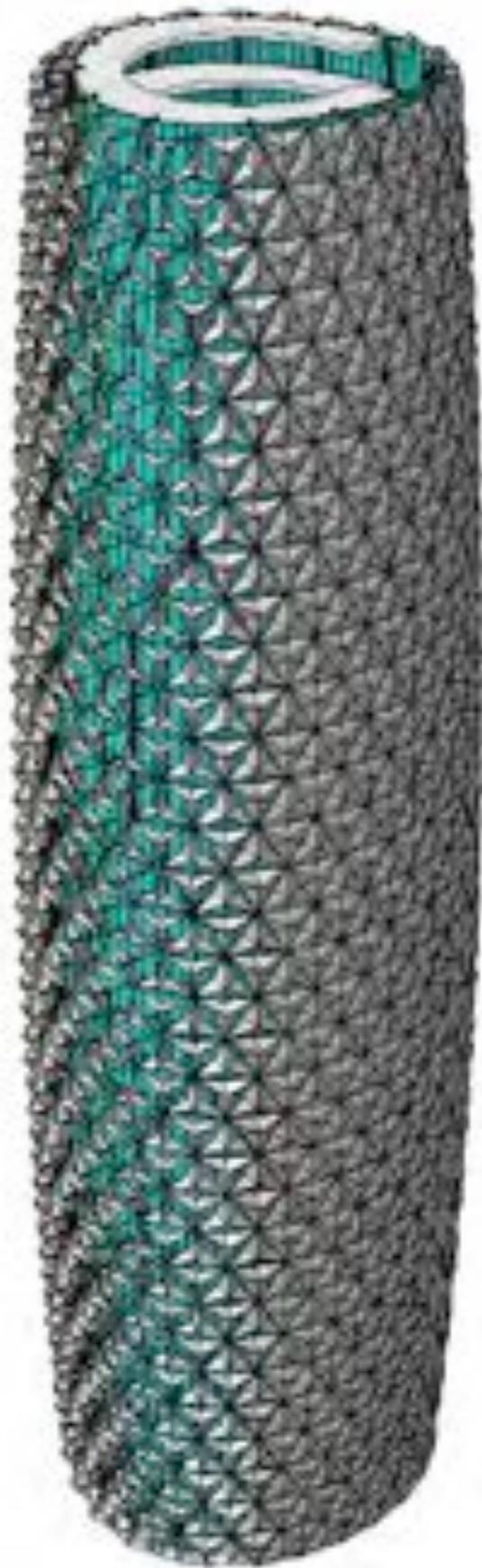
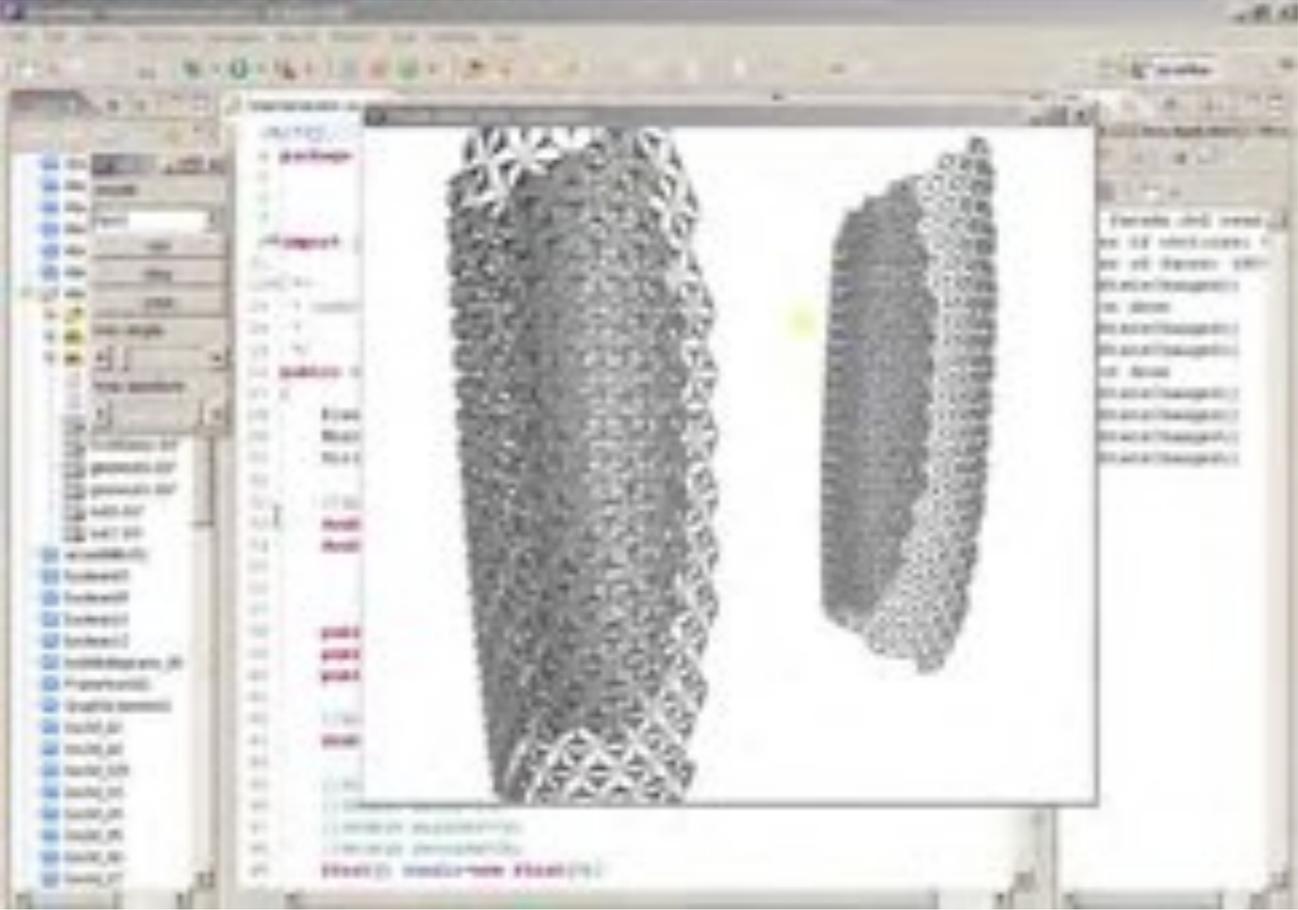
Architecture emerges from self-organization:

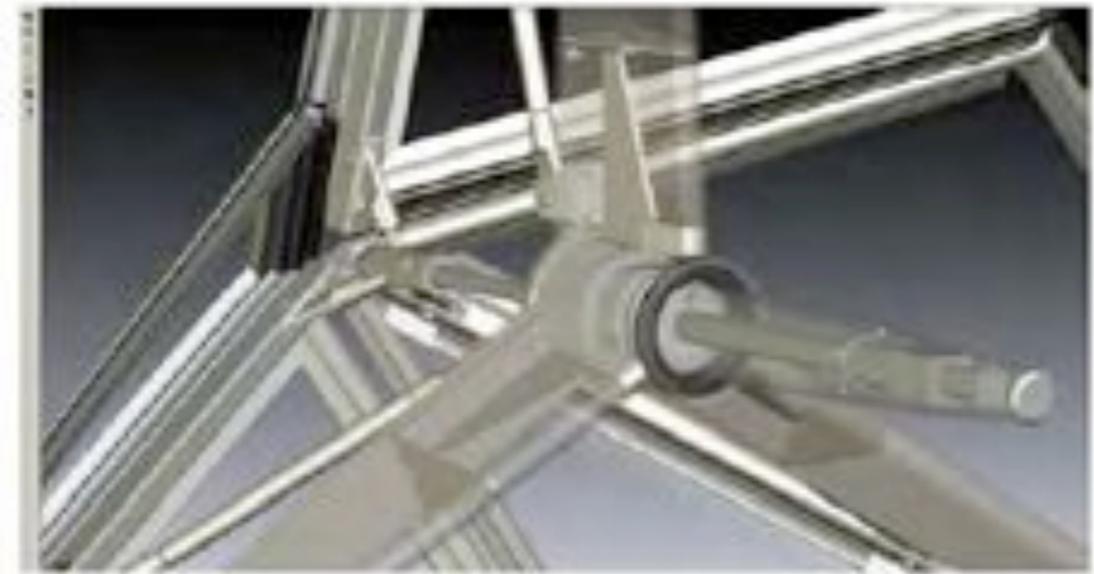
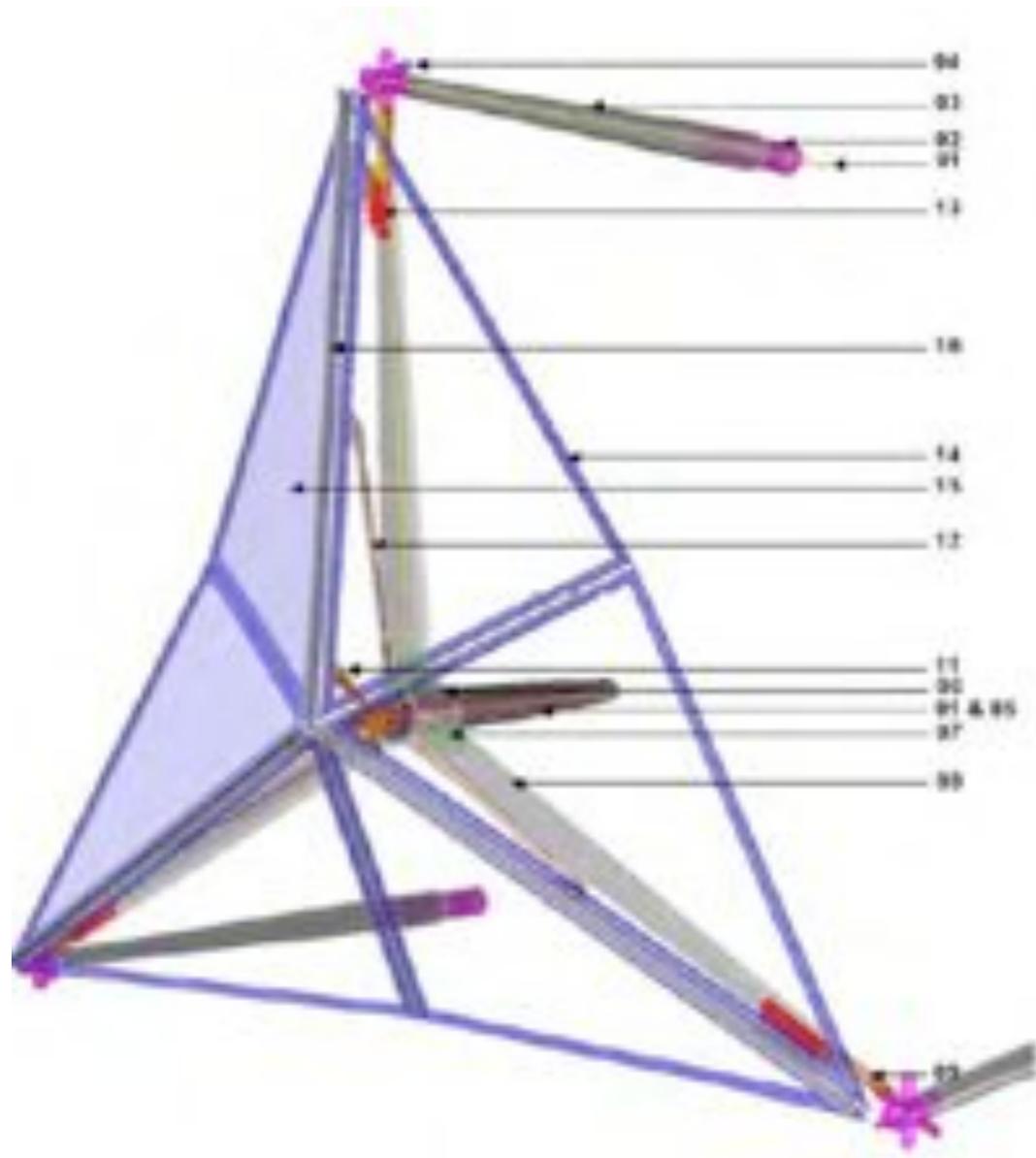
The architect designs the process wherein urban and architectural components organize themselves according to rules towards targeted spatial configurations.



**ADIC Future Solar Responsive Façade
Abdulmajid Karanouh, Aedas Architects**

intelligent automated shading
components linked to computerized
control system





kinetic shading system – triangular units subdivided into 6 triangular flat frames that fold like an umbrella at various angles providing fins/ louver geometries

Benefits:

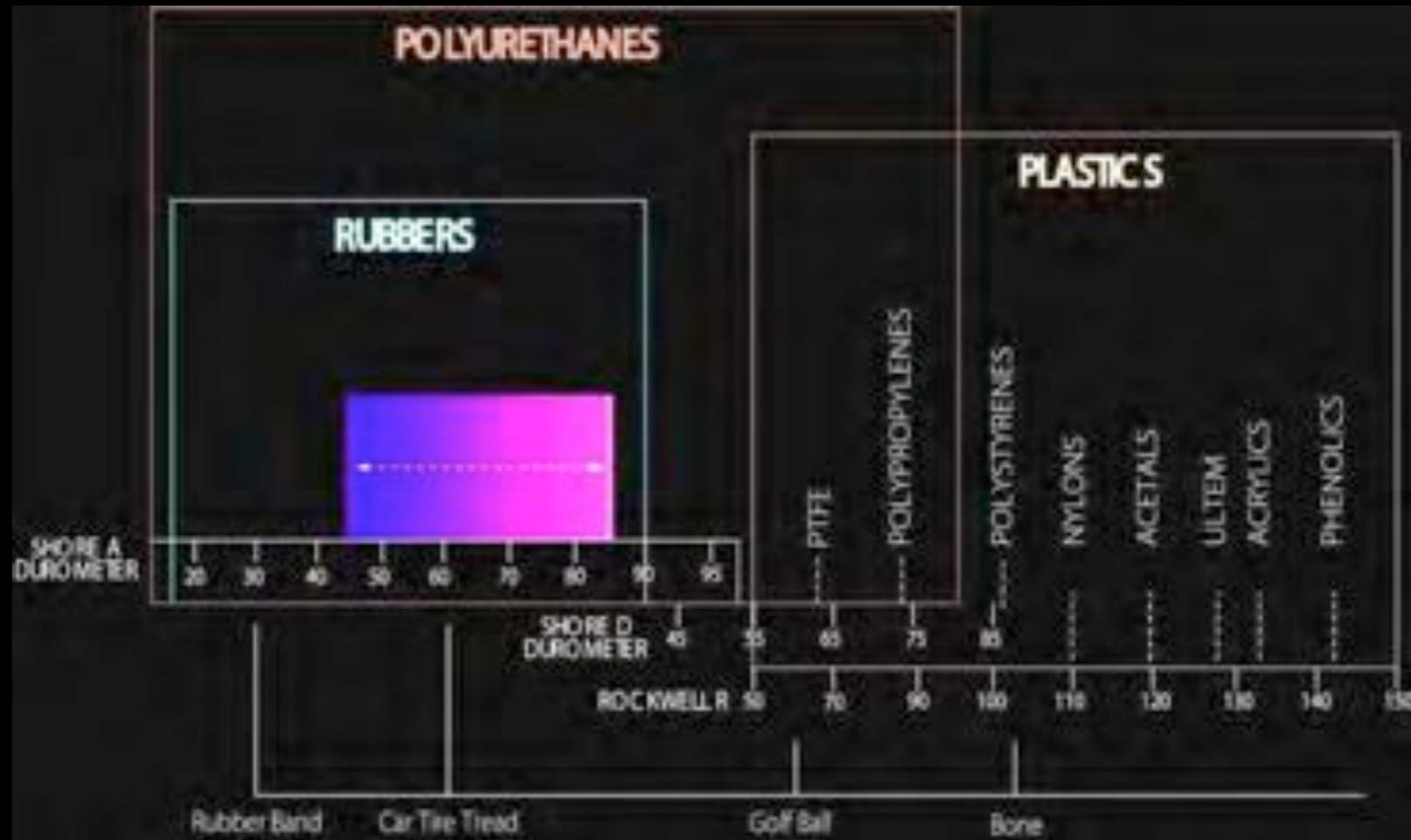
20% energy saving

20% carbon emission reduction

15% reduced plant capital cost

Challenges:

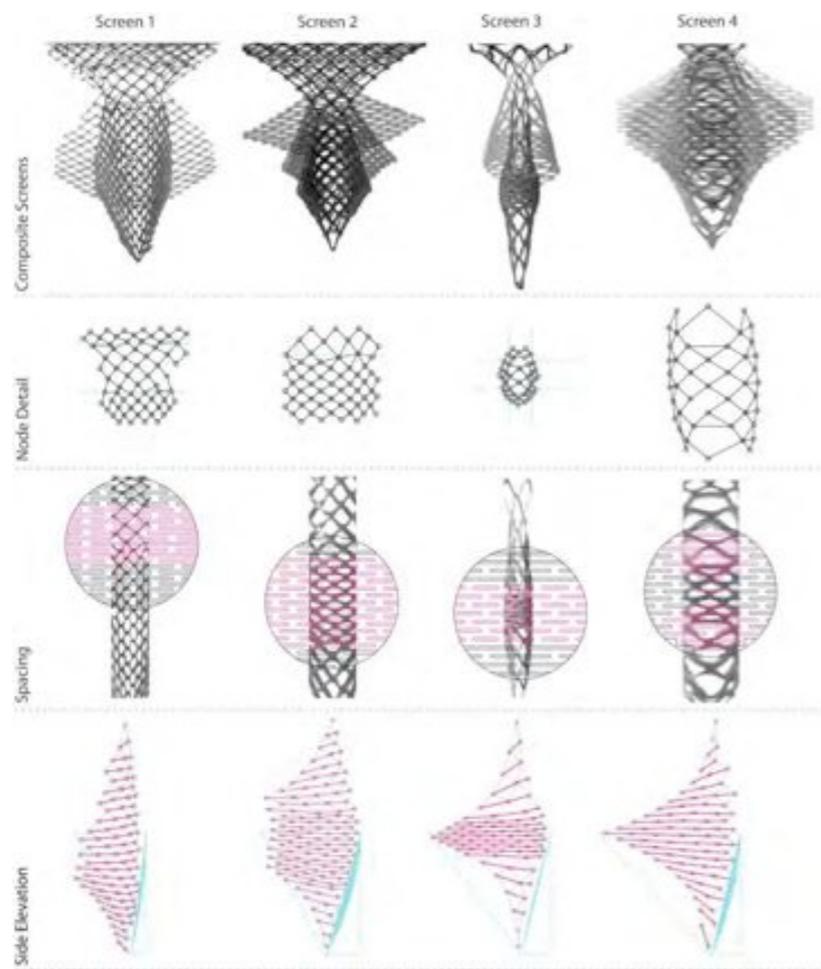
- unique mechanism & kinetic design
- choice of materials
- scale (program & procurement, cost)
- team-coordination



Elasticity- the case for elastic materials for kinetic and responsive architecture

Omar Khan

Situated Technologies Research Group, University of Buffalo



geometries

Grid nets materialized in rubber do not distinguish node from vector.

Varying densities of tightness are instantiated in single material.

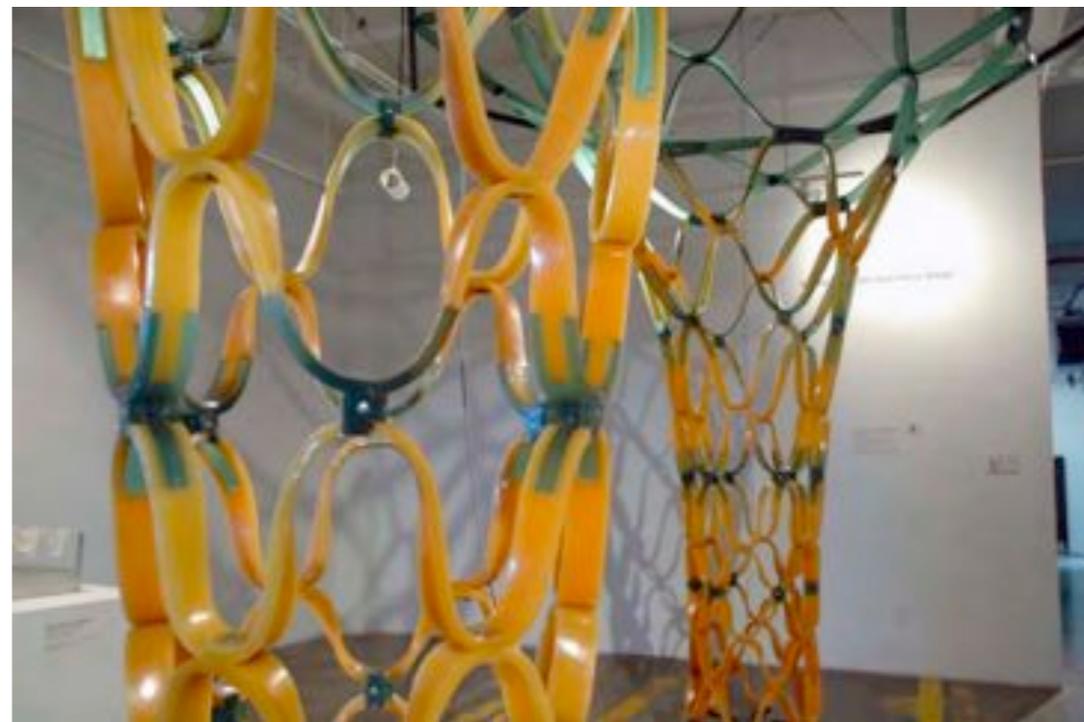


composites

Rendering nodes and vectors in elastomers of different Shore hardness gives structure controlled behavior

Open Columns
system of nonstructural
columns deployed
in patterns to reconfigure
the space beneath.

adaptable architecture
creates gradations of
enclosure based upon
CO₂.



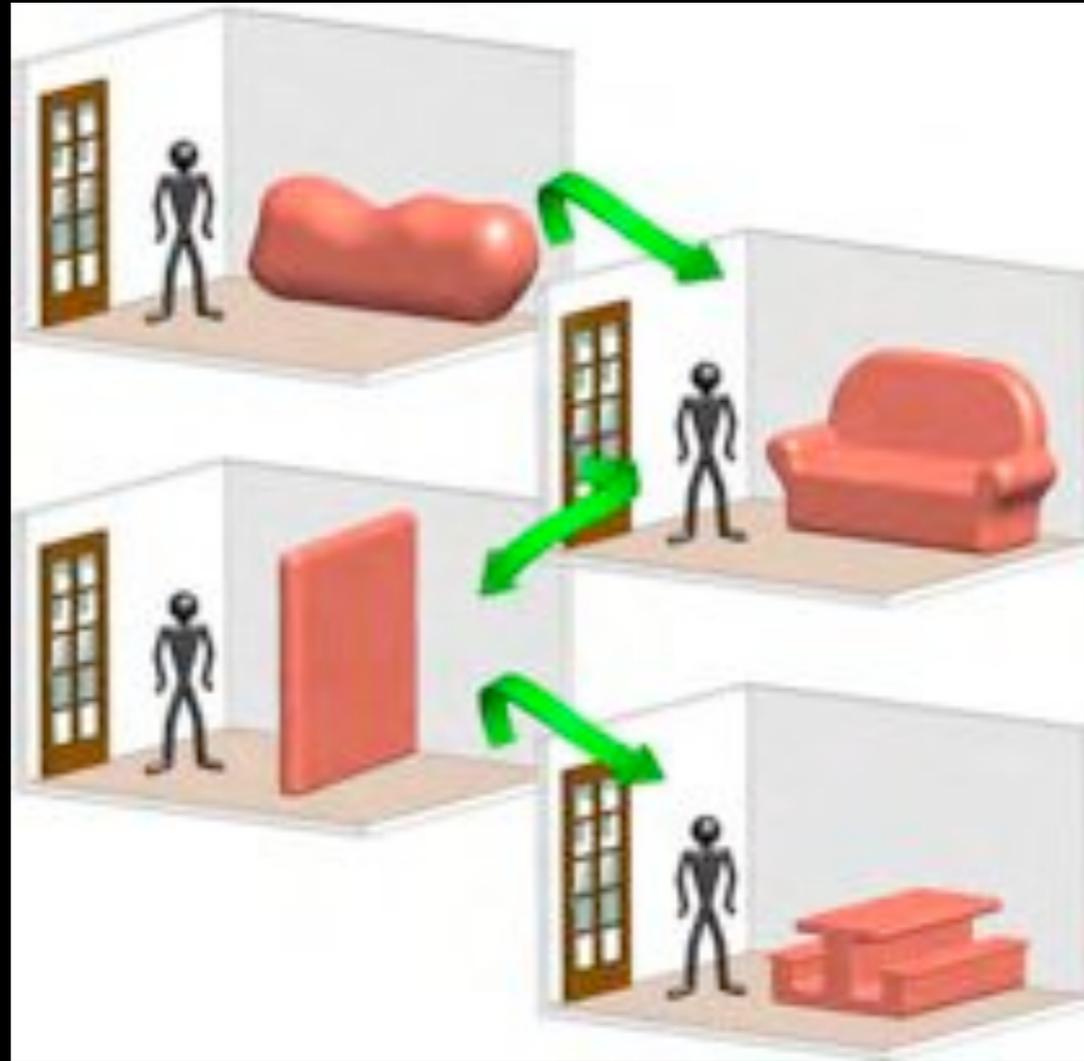
Kinetic behavior directly programmed into a material's composition

Elastomer mechanisms

Elastomer architectural components

Expanding repertoire of elasticities in architecture

Elasticity as computation



Shape-Shifting Materials for Programmable Structures

John R. Amend, Jr.

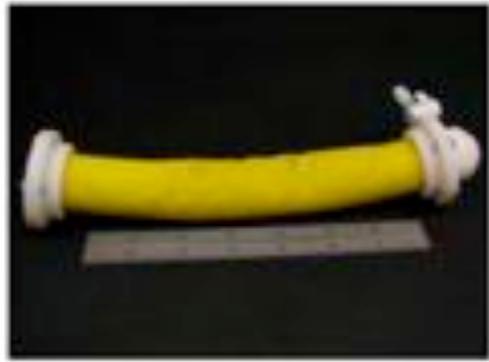
Cornell Computational Synthesis Laboratory

every atom in a programmable matter system need not “think”

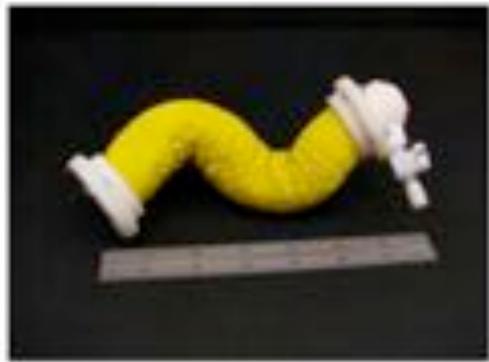


Jamming: granular materials undergo a fluid-like to solid-like phase transition without change in temperature

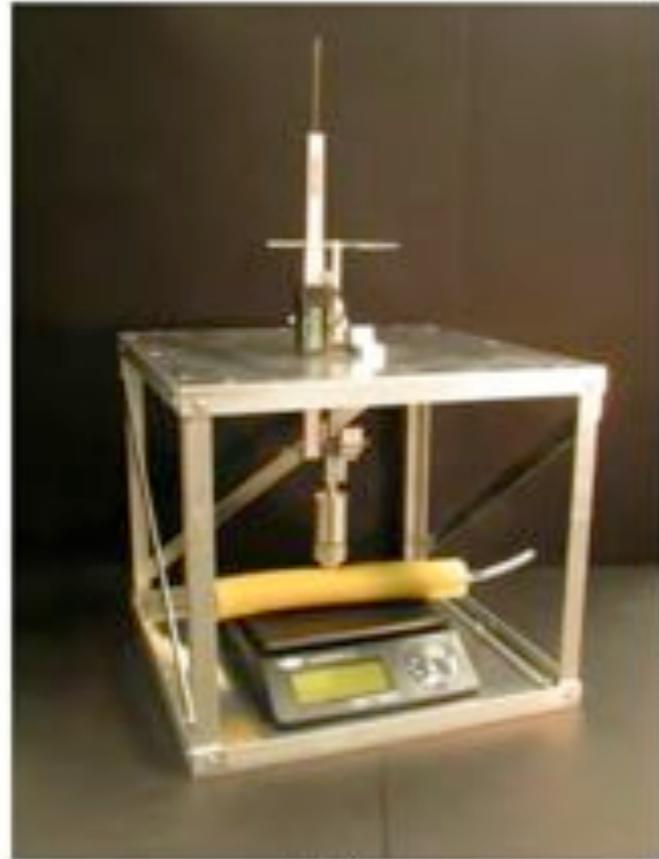
Large areas of goal structure assembled from ordinary granular materials, without decreasing functionality of shape.



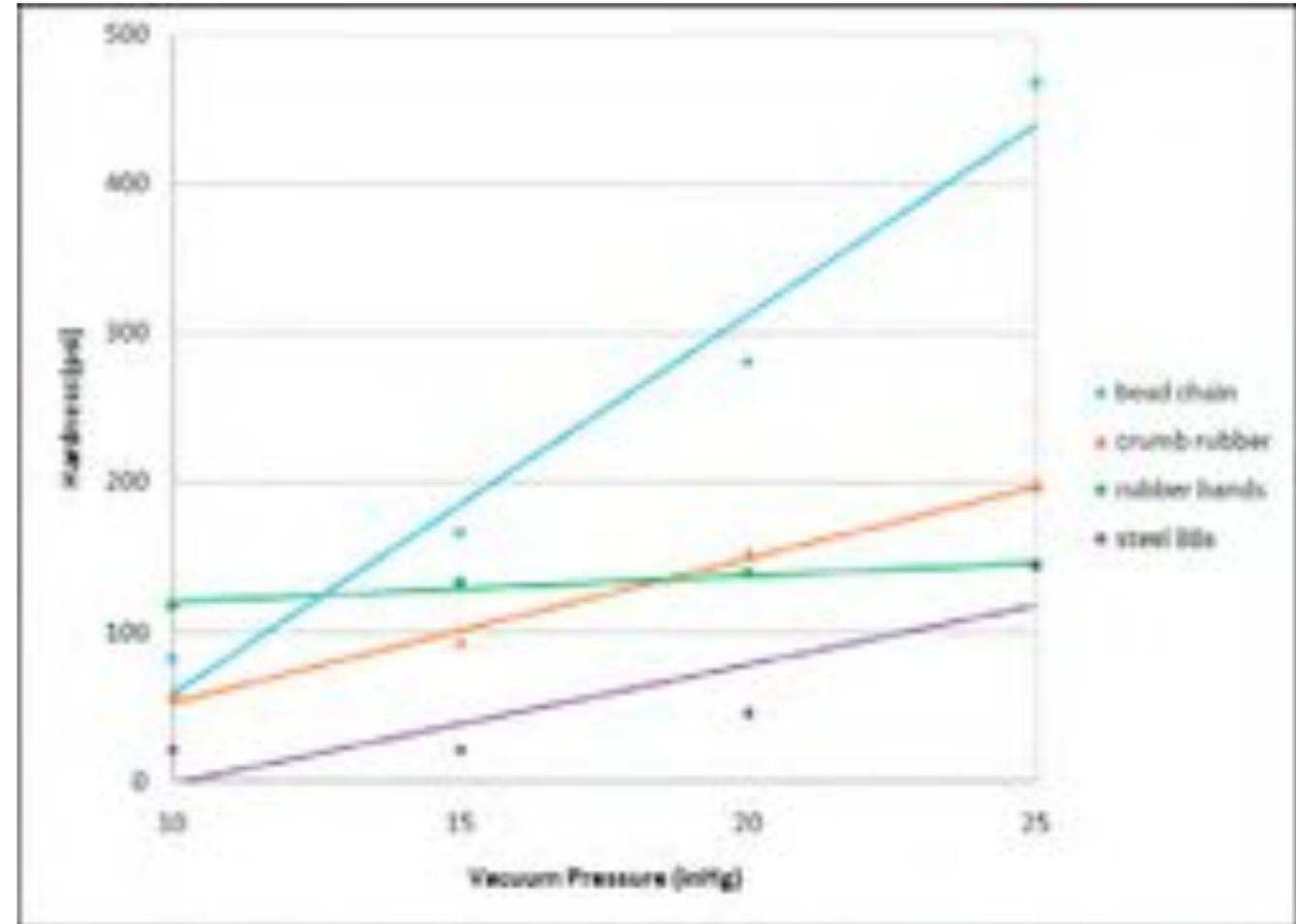
(a)



(b)



(c)



acrylic peanut grains: highest hardness, steepest slope
not hard when un-jammed, hard after jamming



(a)



(b)

Robotic programmable matter beam as a basic construction unit — could be used as frame or truss elements in buildings, bridges, etc. giving reconfigurability, structural health monitoring, and material reuse.

Notes on Habitat-scale Robotics and its Constraints
Benjamin H. Bratton

University of California, San Diego
Department of Visual Arts

Why, especially now, do we need robotic architecture at all?

We are designing the *second* planetary computer: The assignment for habitat-scale robotics: to absorb worldly demands and better mediate them.

We now ask software to do things we asked of architecture (e.g., the bank).

Robotic architecture must *reduce, not increase*, the amount of architecture in the world.

To allow more customizable habitats robotic architecture must prove capable of providing degrees of freedom that furniture cannot, and/or capable of providing the same programs with greater mobility and efficiency. Until then furniture wins—it is cheaper, lighter, and simpler.

Introducing robotics can make possible forms of urban-scale spatial recombincancies ... displacing zoning, jurisdiction, ... legal governances of place and the unsustainable presumption of monoprogrammatic architectures.

a preferable future of robotic architecture:
prudent content management of existing stock of
architectural partitions and surfaces.

tradeoff: added energy costs for robotic architecture
vs. benefits of flexible architectural forms



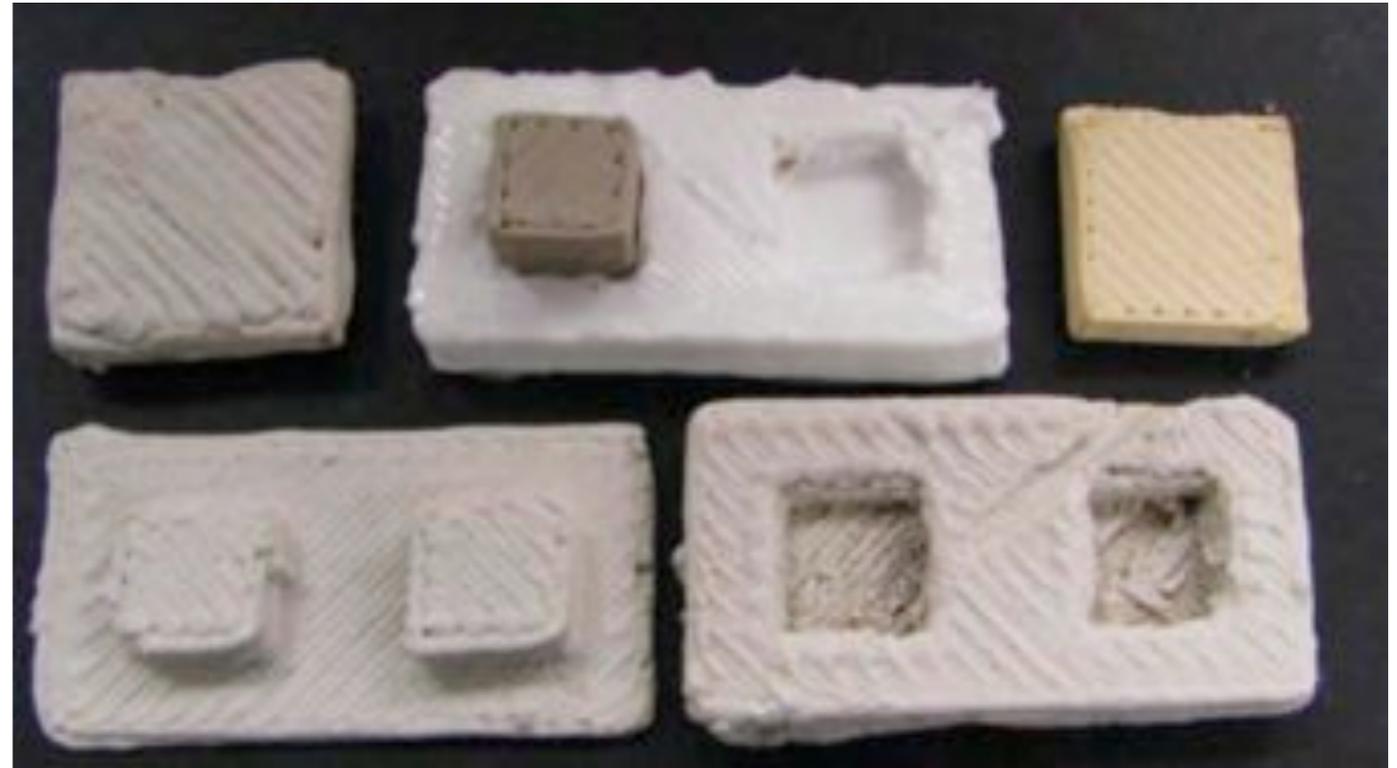
Brick-Printing Technologies for in-situ Smart Structure Fabrication

Jeffrey I Lipton

Cornell Computational Synthesis Laboratory

Create intelligent building structures and systems using smart bricks.

ceramic bricks, tiles, cubes & interlocking bricks, conductive silicone, epoxy, cement, strain gauges, fluidic & electrical conduits, thermocouples, organic transistors, actuators, batteries, living cells,



- real time monitoring building deformation and loads.
- collect real time thermal performance information.
- sensors in the building blocks.
- a room changes form to meet function.
- non load bearing wall curves to improve acoustics.
- emergency lighting blends seamlessly with building.
- living, breathing systems integrated into buildings.



Towards the Future of Collaboration: Two Cases on the Design of Archi. Robotics

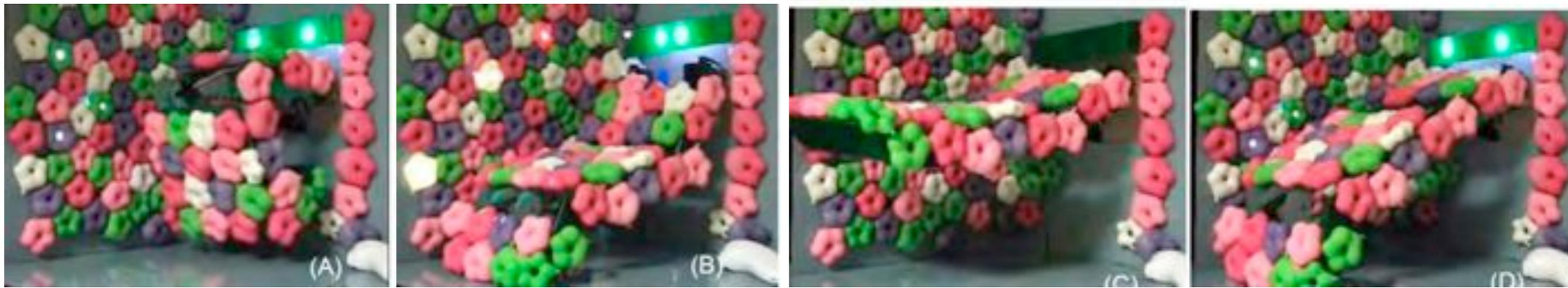
Henrique Houayek & Paul Yanik
School of Architecture, Clemson University

transdisciplinary class:
architecture and engineering students
collaborate in search of new design processes.



Floor sensors detect presence, adjust chair to easy sitting position.

Accelerometer in clothes modifies chair angles, triggers inflatable system, injecting air into cushions— changing form to improve comfort.



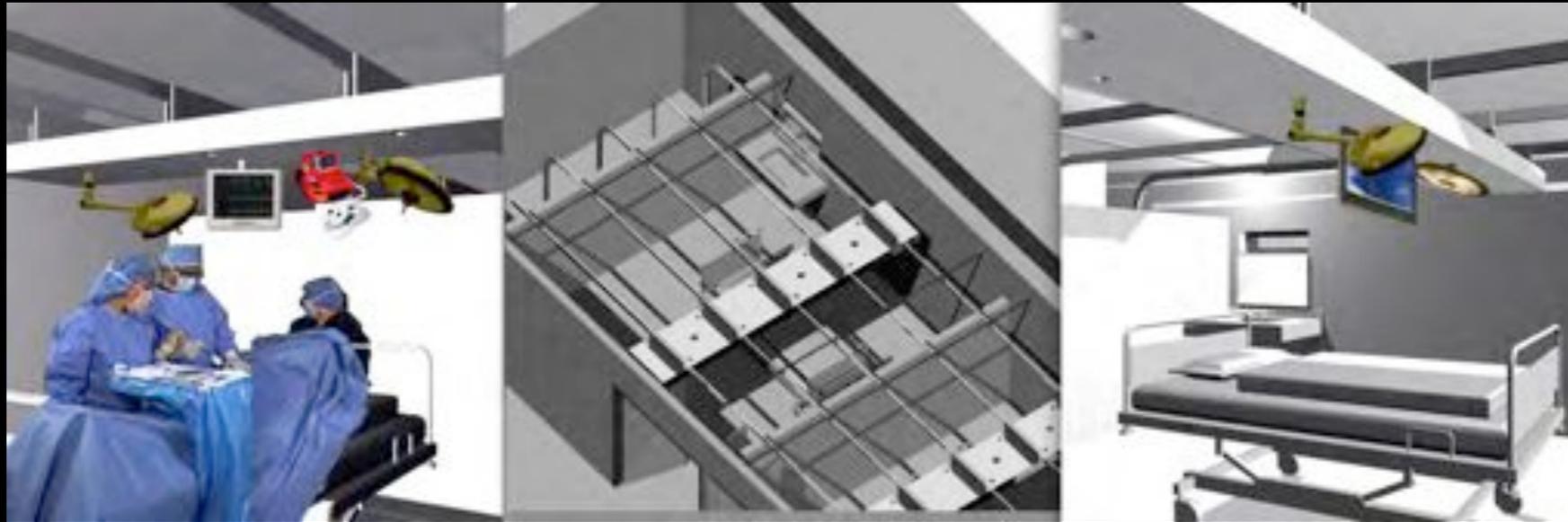
Sensors detect head position; chair changes shape to sleeping mode; if person falls asleep, chair asks room to turn lights off. When head movement detected, room lights turn on & chair returns to sitting position.

Upon rising, the chair adjusts to standing position, adapts form to each user's habits needs and provides comfort for people who require special care.

Architectural-Robotics for 2019:

Answers to life problems and opportunities
through how these technologies
—embedded in architecture—
forward interaction across people and surroundings
to create places of social and psychological significance.

Support human activity, respond naturally to needs.
Interaction complements and redefines our urban living patterns.



Floor, Come and Embrace Me!

Ellen Yi-Luen Do

**College of Architecture; School of Interactive
Computing; GVU Center & Health Systems Institute
Georgia Tech**

Hoberman Associates: Adaptive Fritting



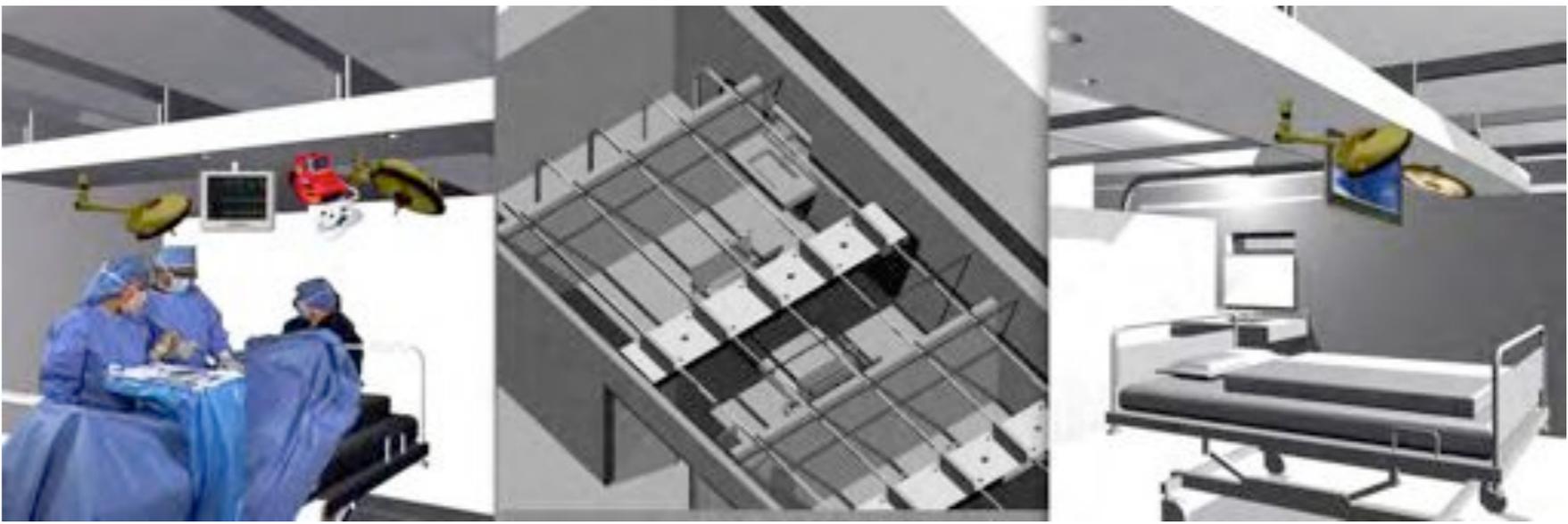
Giselbrecht: Technic Showroom



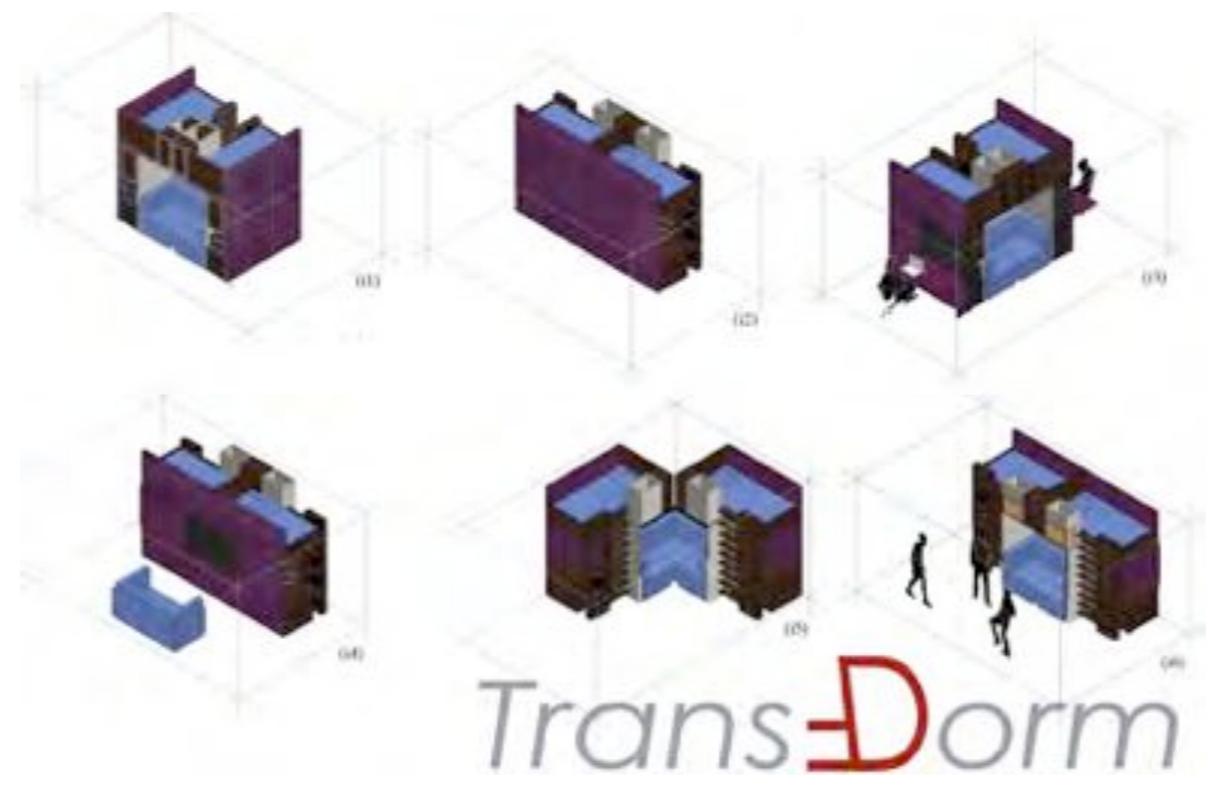
Ned Kahn: Wind Portal (l) Articulated Cloud (r)



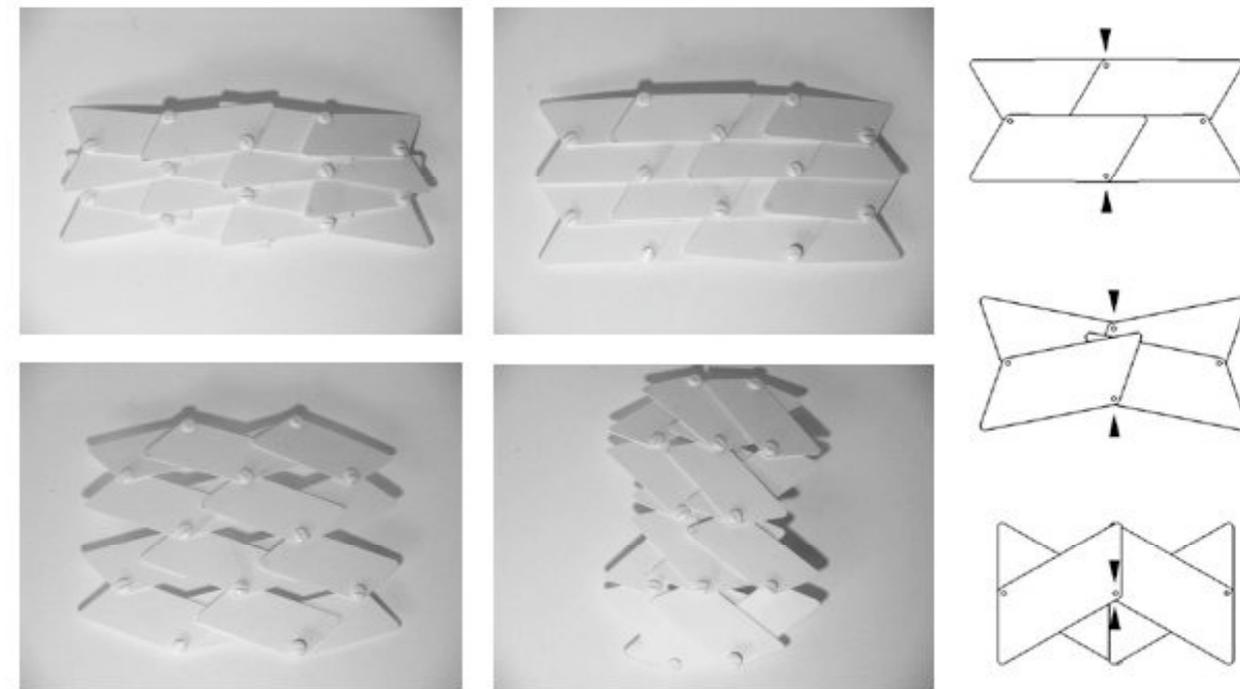
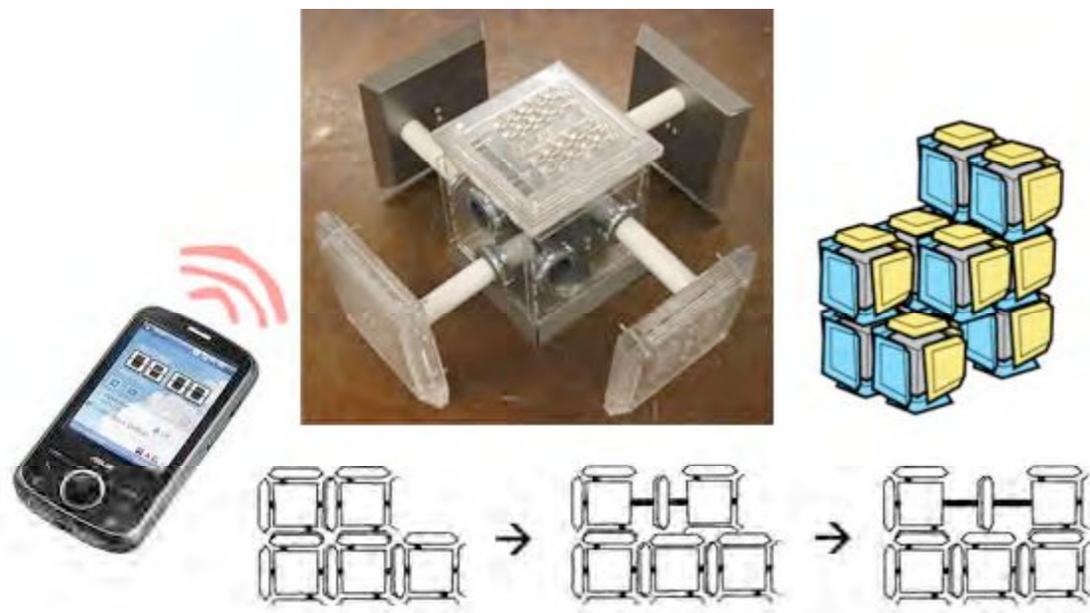
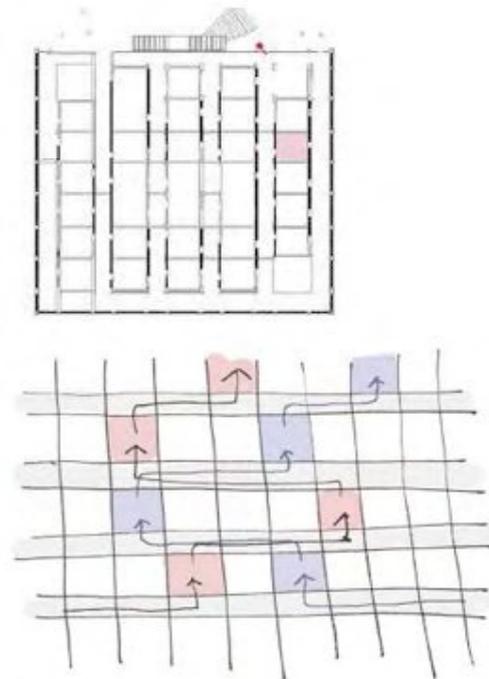
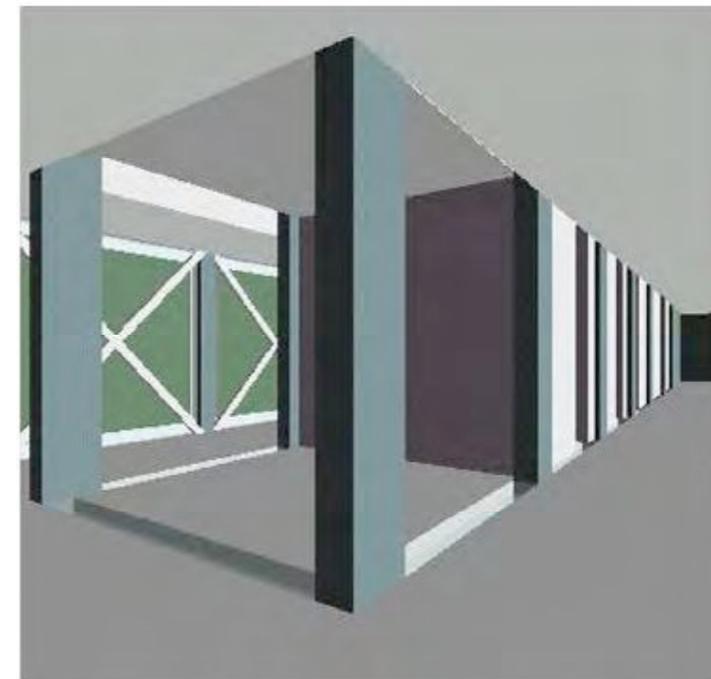
“care on a rail”
shareable medical
resources mounted
on ceiling sliders



convertible
multi-
purpose
two-person
dormitory
unit



- Digital Animation Museum
- Fabric building envelopes
- Espresso Blocks



Architectural Robotics: Unpacking the Humanoid
Ian Walker

Department of Electrical and Computer Engineering
Clemson University

Two views of robotics:

- Orwell — attached/embedded sensors (“watch, perceive, and advise”)
- Čapek, Asimov — self-contained robots (“investigate, fetch and carry”)

Unpacking the robot:

distributing functionality in architectural framework

- environment designed with programmable movement
- collective intelligence of environment distributed
- intelligence should not do things for the occupants, but instead help them do things.

- to what extent will static environments, however sensor-rich and compute-rich, satisfy general needs of motion-hungry humans?
- which mass-moving capabilities should be “unpacked” from robotics into the environment?

an ensemble of simple programmable moving elements integrated into the overall environment, each with a specific function, each working as integral components of an ensemble

example

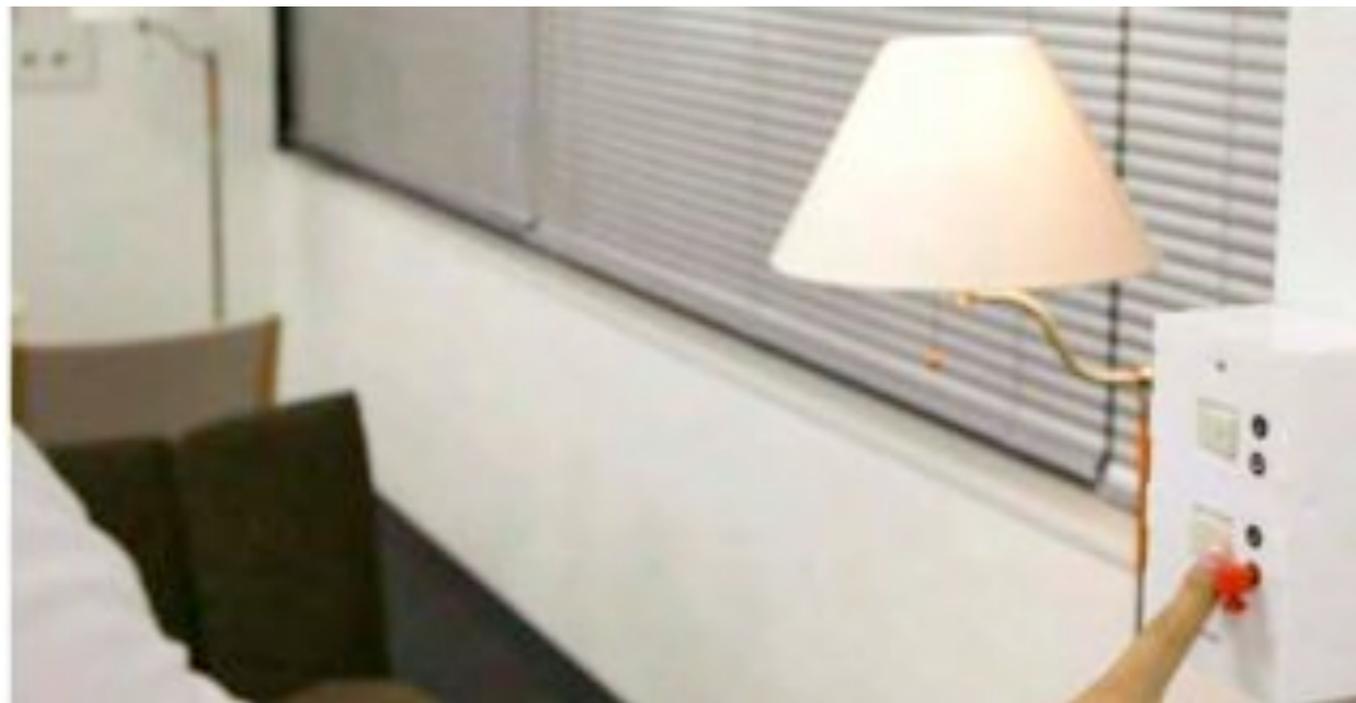
- A nursing home robotic organizer/storage retrieval system.
- Organizer stores, shuffles modular “drawers” integrated with physical surroundings.
- A robot “tongue” emerges from the wall to deliver and retrieve selected modules on demand.
- A bed-ridden human provides complex and higher-level actions, organizing, identifying, and manipulating objects.
- The physical environment provides low-level logistics.



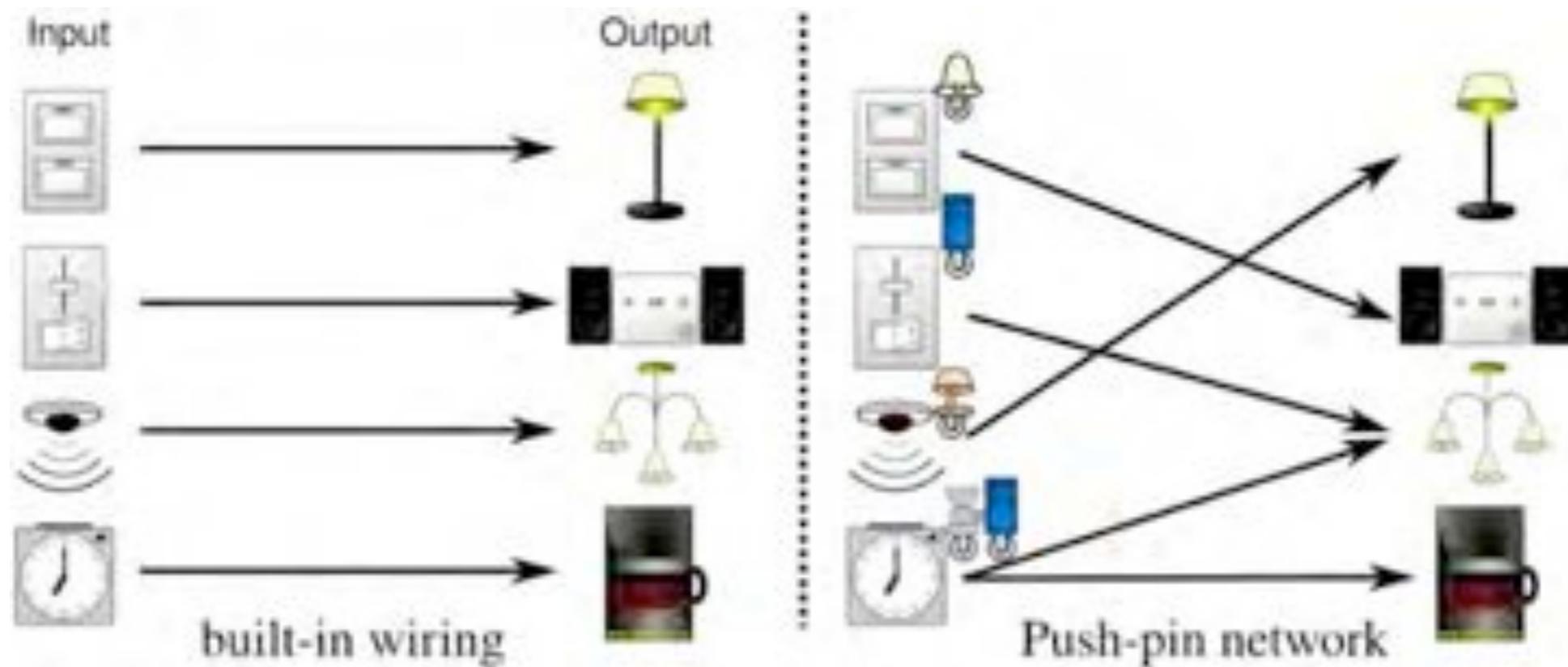
Push-pins: Design-by-user Approach to Home Automation Programming

Kentaro Fukuchi
Japan Science and Technology Agency

tangible programming interface
occupants program and configure smart systems

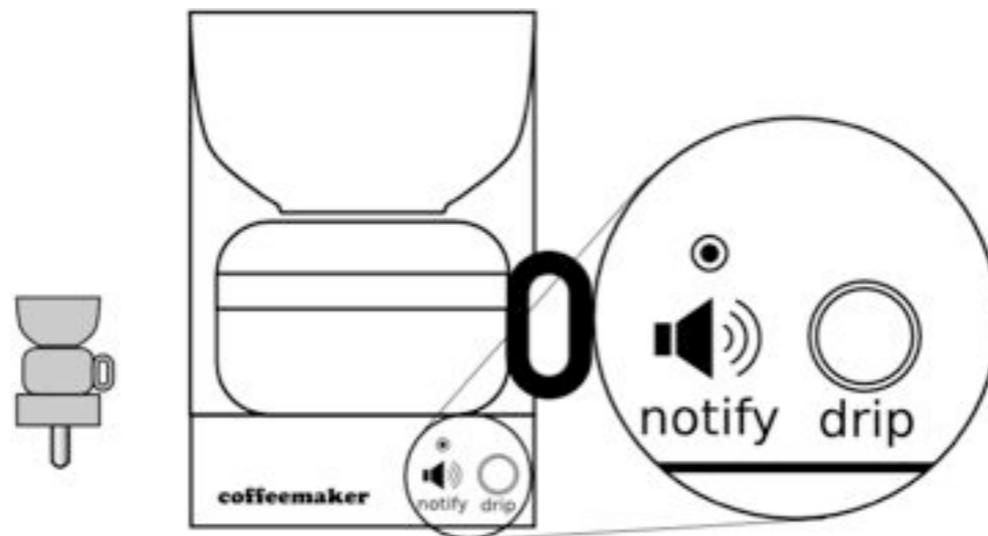


stimulus-response model:
one appliance connected to another,
one activates the other



decrease TV volume when on the phone
water the lawn when not raining
reminder: trash day every Monday

input: switch, dimmer panels, motion sensors, clock
output: multipurpose outlet & melody modules



coffeemaker:

starts brewing when ON signal from “start brewing” pin
notifies another module when it stops brewing



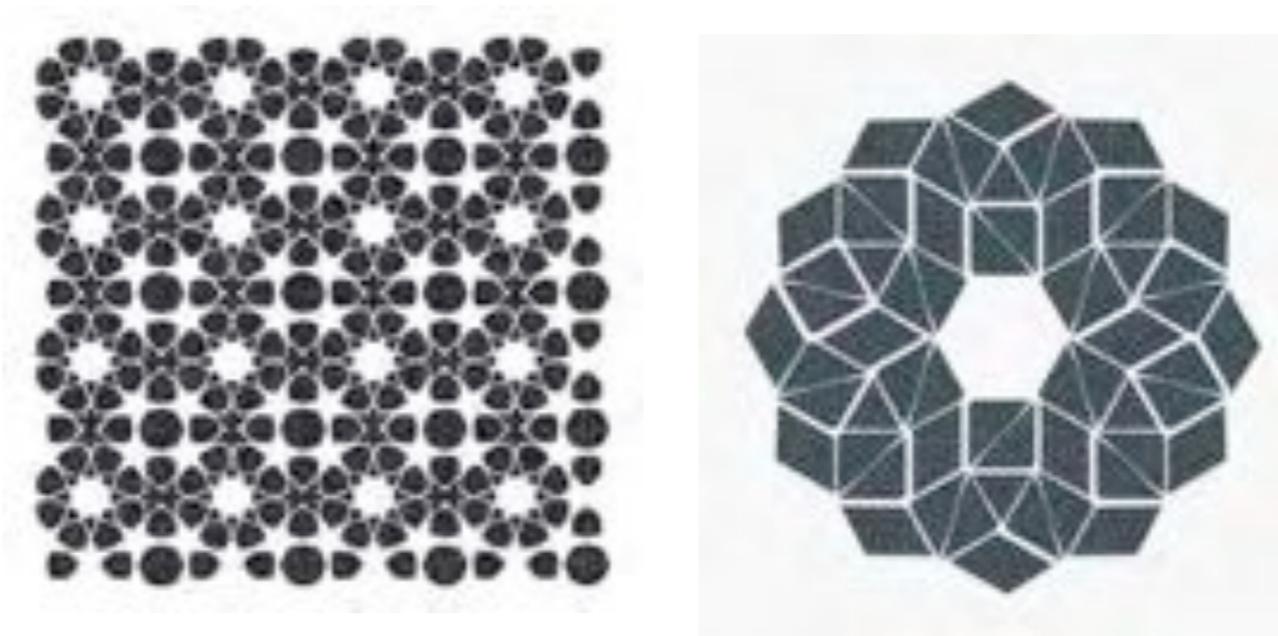
Smart textiles as actors and actuators of the domestic space
Aurelie Mossé

Centre for IT & Architecture, Royal Academy of Fine Arts
Copenhagen, Denmark

smart textiles lead to a different understanding of domestic space

textile filter between body/space, outside/inside, public/private

Photovoltaic Mashrabiya: a soft solar-responsive membrane

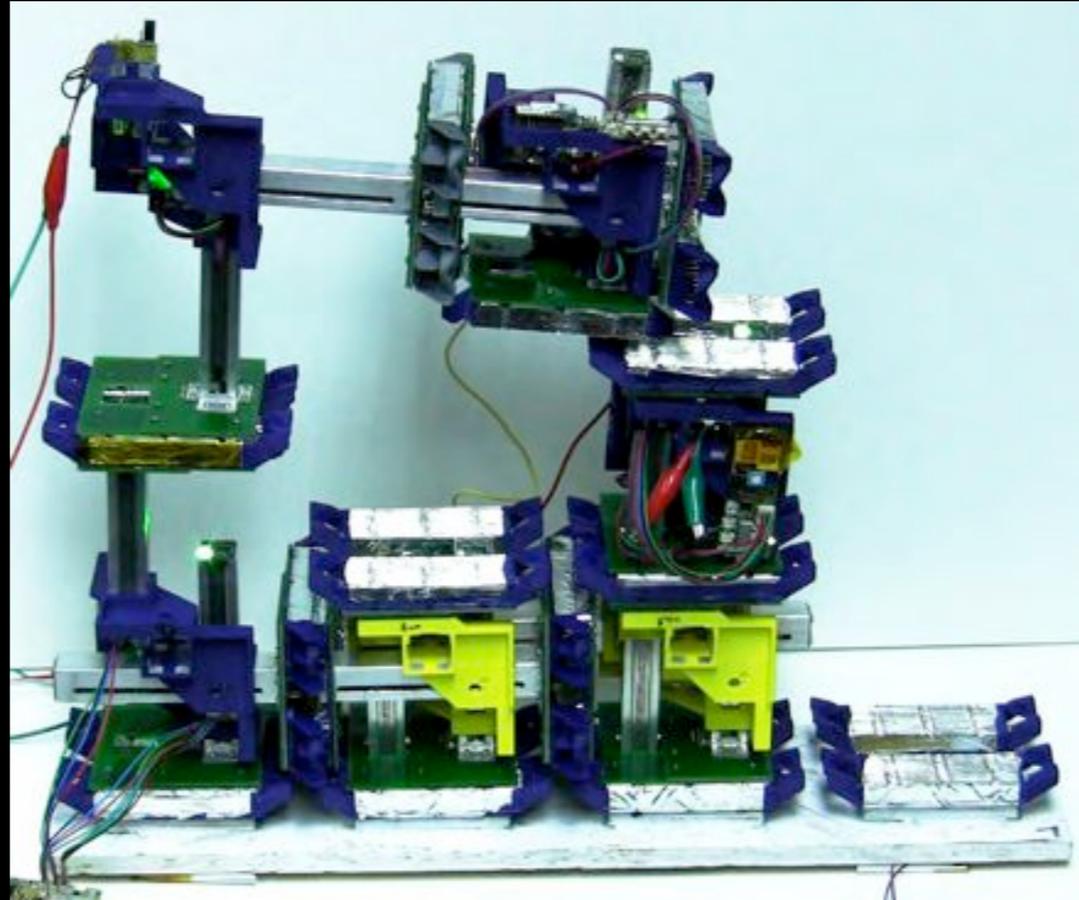


soft photovoltaic membrane changes shape with sunshine

membrane converts sunshine into electricity and changes shape/
permeability to filter light and solar-heating

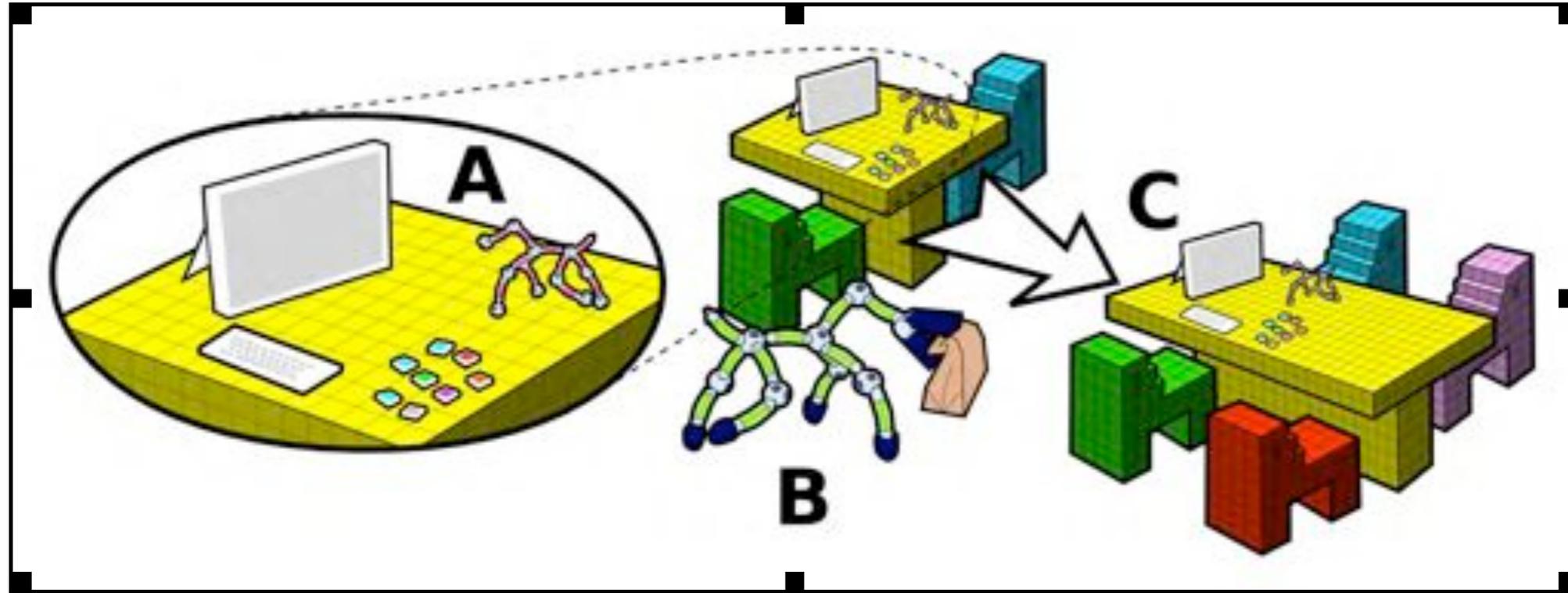


using a standard solar rectangular module,
how pattern and textiles logic (origami, folding, sandwich-
construction combines low-weight with high stiffness and strength,
and appliqué techniques— smaller ornament or device applied to
another surface)
can enhance visual and tactile qualities.



A Framework for Making with Robunculi Michael Philetus Weller

CoDe Lab and Claytronics Group
Carnegie Mellon University



“robunculus” = robot + homunculus

A. tangible sketching kits: relationships, forms & behaviors

B. golems: chores and errands;

C. hyperforms: change shape over time

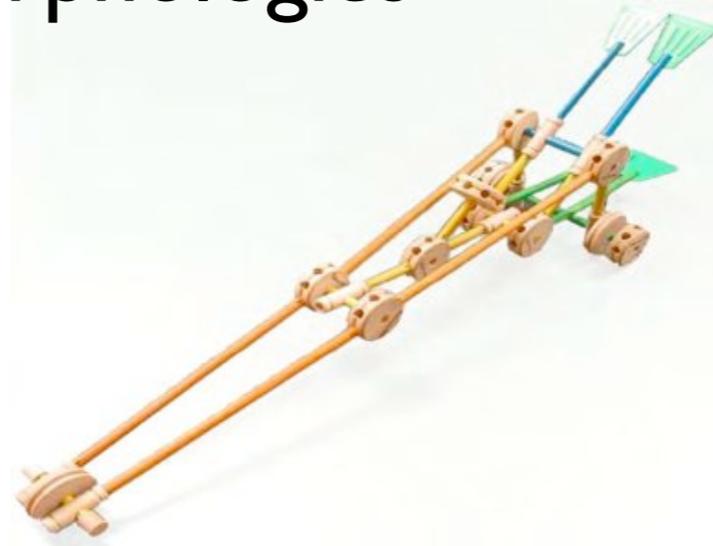
4 morphologies



tiles



blocks



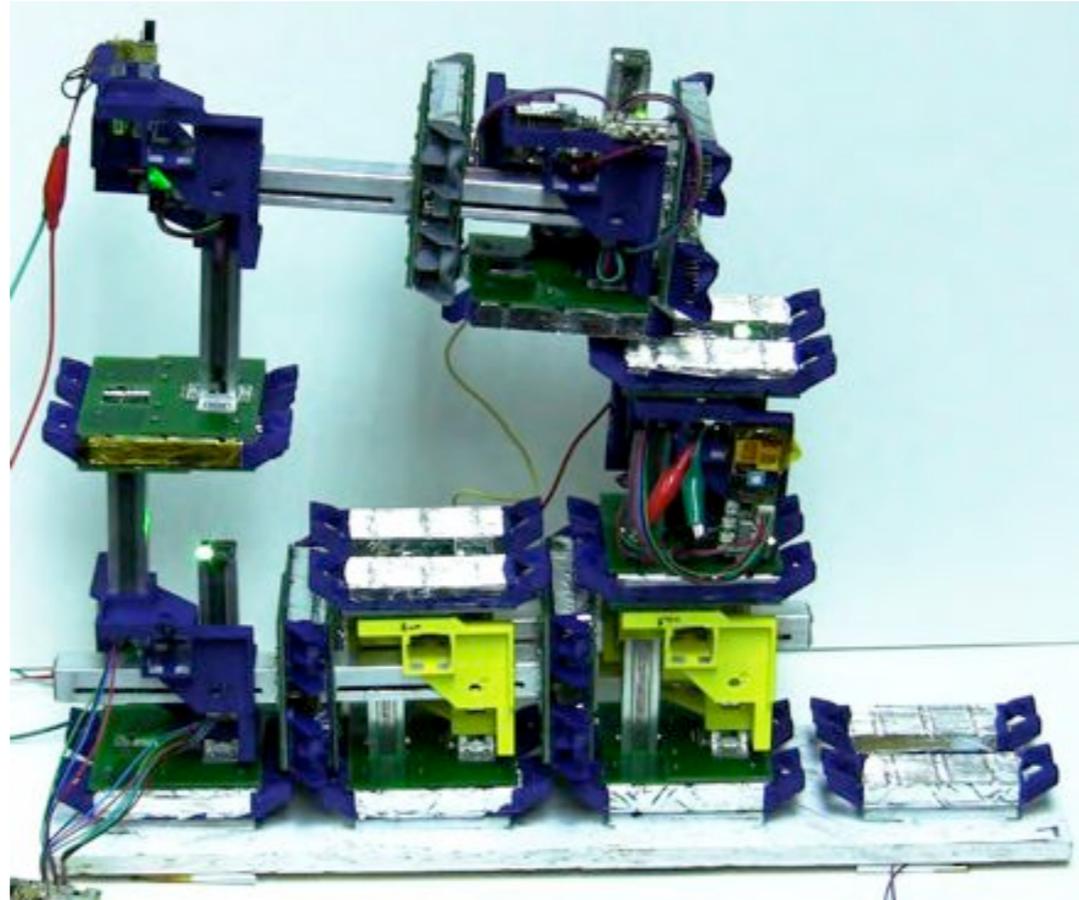
graphs



panels

3 x2 manipulative affordances

input	placing	posing	commanding
output	self-reconfiguring	self-posing	signalling



Prismatic Cubes

combining tangible interfaces and modular robotics
create ensembles of robotic modules that respond to
tangible and gestural interaction
to control their behavior and adapt their form

'What we [still] ask to our home is to be a place that makes sense, that produce meaning'. Susani

Smart materials are completely challenging the way of thinking and designing space as they 'are dynamic in that they Behave in response to energy fields - Addington & Schodek

Inside and the outside become interconnected, the inside becoming an effect of the outside — Grosz

An architecture is a “control programme” that is “catalyst, crutch, memory, and arbiter” for its inhabitants — Pask

The format of the man-machine relationship is the goal of humanism through machines.... The concern is to avoid dehumanizing a process whose aim is definitively humanization — Negroponte

Recently things are becoming less and less “something to do something else” and increasingly “something that does something. — Manzini

Team members respect each other's disciplinary norms, rewards and sanctions ... team members benefit by engaging in tasks that are not part of their normal work — Zeisel

Uniqeness is now as easy and economic to achieve as repetition. — Slessor

The result is likely to be that the system mispredicts often and annoys the inhabitants more than it supports them – Mozer

Architecture machines “won’t help us design; instead, we will live in them –Negroponte

Not everybody wants to live in a balloon – Negroponte

The best way to predict the future is to invent it – Kay

... a sensing device, a control algorithm, a change mechanism, and a control setting – Eastman

A house is a machine for living in – Le Corbusier

The role of the architect here ... is not so much to design a building or city as to catalyze them: to act that they may evolve – Pask

Think how hard physics would be if particles could think—Gell-Man

Feenberg Asimov
Latour Martin Gardner
Orwell Le Corbusier
Kay Pask
Thackera
Negroponte Forty
Schodek Toffoli & Margolus
Ishii
Chapman
Norman Gell-Mann
Intille Mumford Yim
Çapek Vitruvius Shneiderman

non-standard
architecture

jamming

floor embrace

elastics

architect's role

solar façade

materials

textiles

applications

unpacking
humanoid

self-organizing

print-a-brick

programmable matter collaboration

interacting

push-pins

how?

end of architectural
robotics

why?

nano-meta-morphic

robunculi

discussion