Shape as Media

“Where the sea meets the land, life has blossomed into a myriad of unique forms in the turbulence of water, sand, and wind. At another seashore between the land of atoms and the sea of bits, we are now facing the challenge of reconciling our dual citizenships in the physical and digital worlds.”

Ishii, H. 2008. Tangible bits: beyond pixels. In Proceedings of the 2nd international Conference on Tangible and Embedded interaction (Bonn, Germany, February 18 - 20, 2008). TEI ‘08. ACM, New York, NY

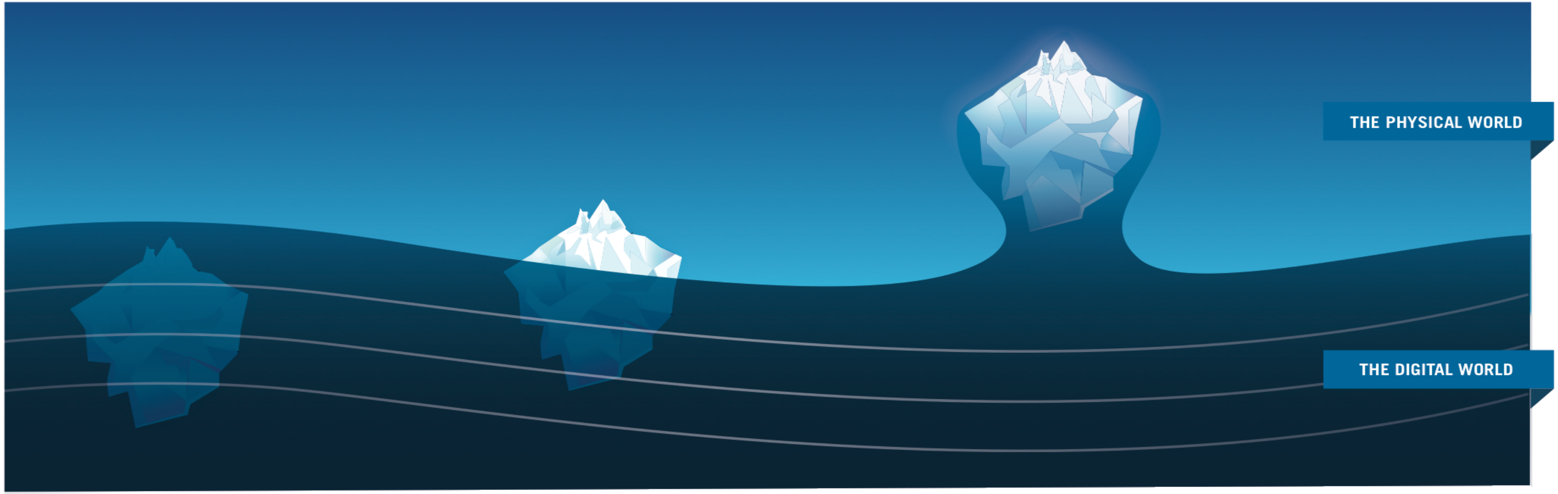
Physical -> static, passive and permanent
Digital -> dynamic, active and programmable

Physical -> Take on Shapes
Digital -> Virtual and Intangible

GUI PAINTED BITS

TUI TANGIBLE BITS

RADICAL ATOMS



A Graphical User Interfaces only let users see digital information through a screen, as if looking through a surface of the water. We interact with the forms below through remote controls such as a mouse, a keyboard or a touch screen.

A Tangible User Interface is like an iceberg: there is a portion of the digital that emerges beyond the surface of the water - into the physical realm - that acts as physical manifestations of computation, allowing us to directly interact with the 'tip of the iceberg.'

Radical Atoms is our vision for the future of interaction with hypothetical dynamic materials, in which all digital information has physical manifestation so that we can interact directly with it - as if the iceberg had risen from the depths to reveal its sunken mass.

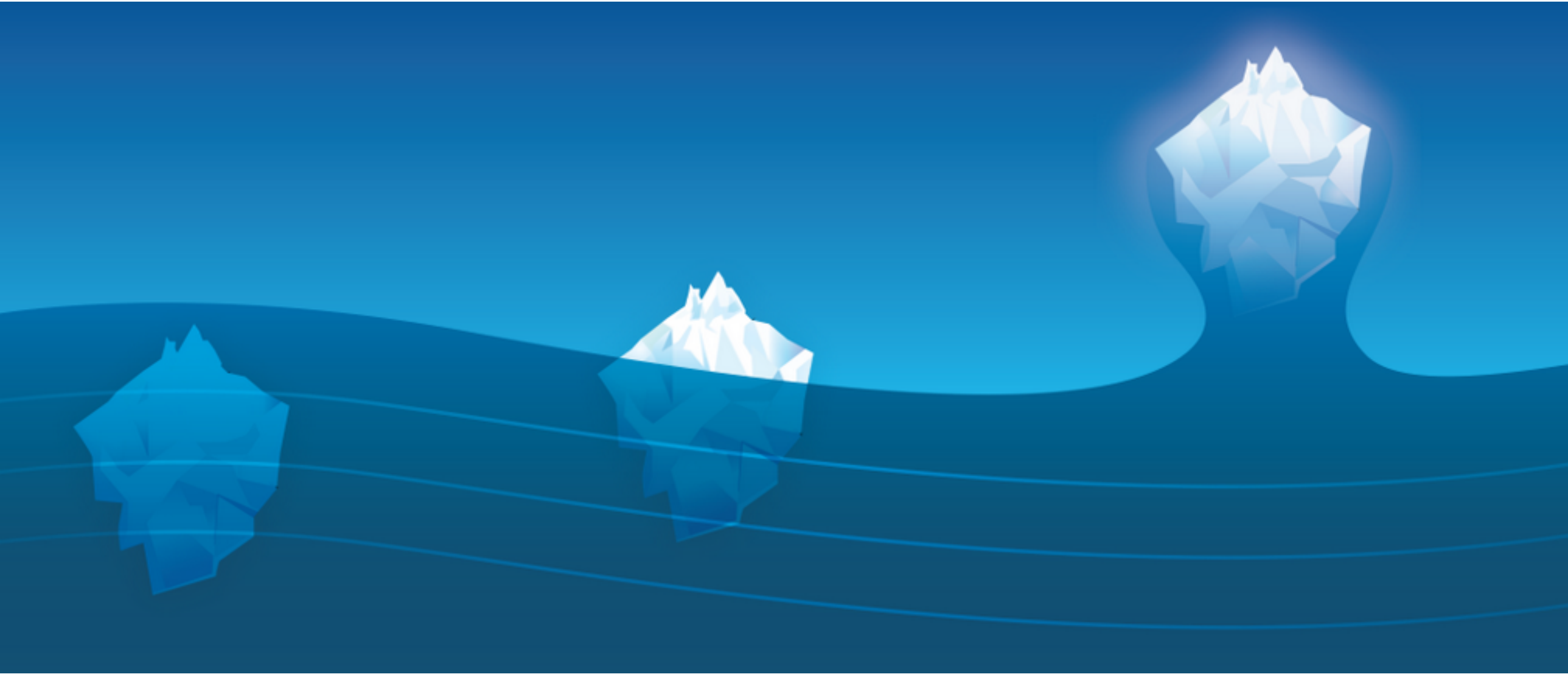
"Radical Atoms" is our vision of human interactions with the future dynamic physical materials that are transformable, conformable, and informable.

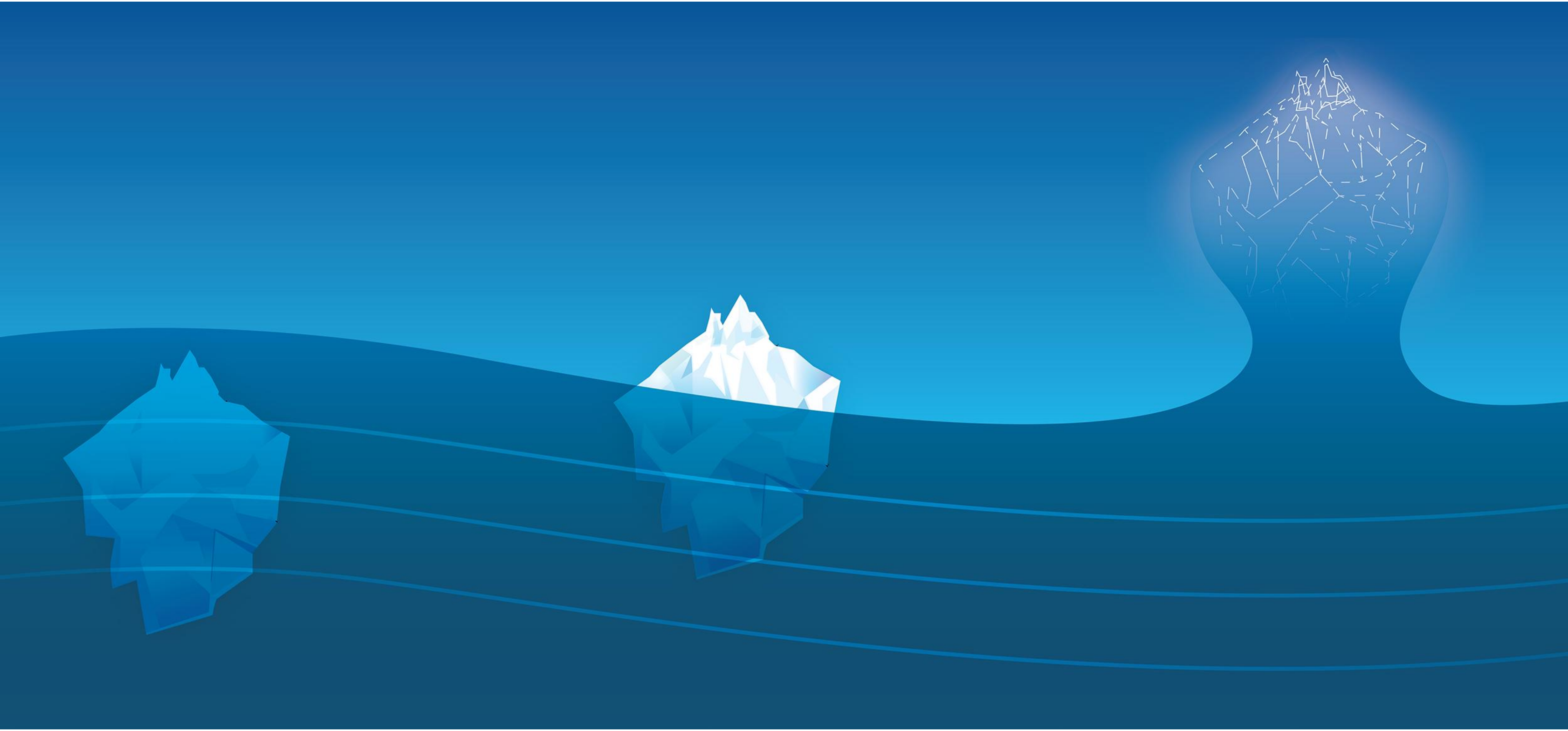
Tangible Media Group
MIT Media Lab

How?
Why?

How?

Why?

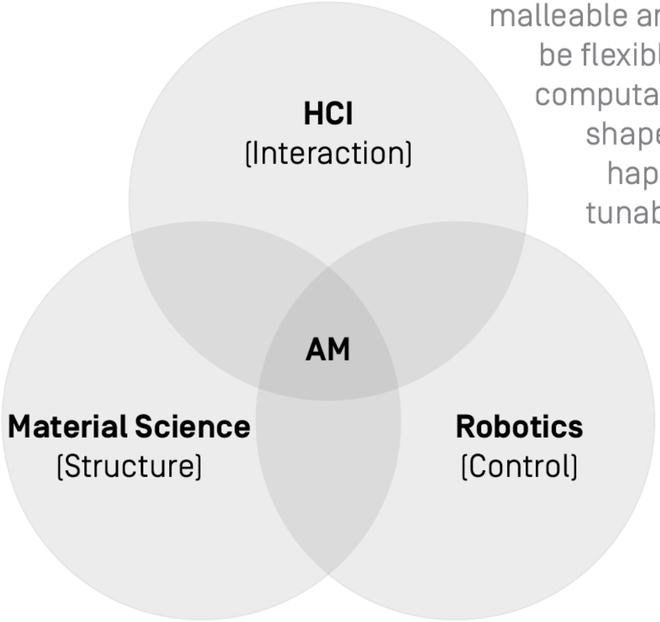




How?
Fabrication problem.
Mechanical and electrical engineering problem.
Material science problem.
Biological and chemical science problem.
Why?
Interaction problem.
Design and psychology problem.

Multidisciplinary Background - 2013

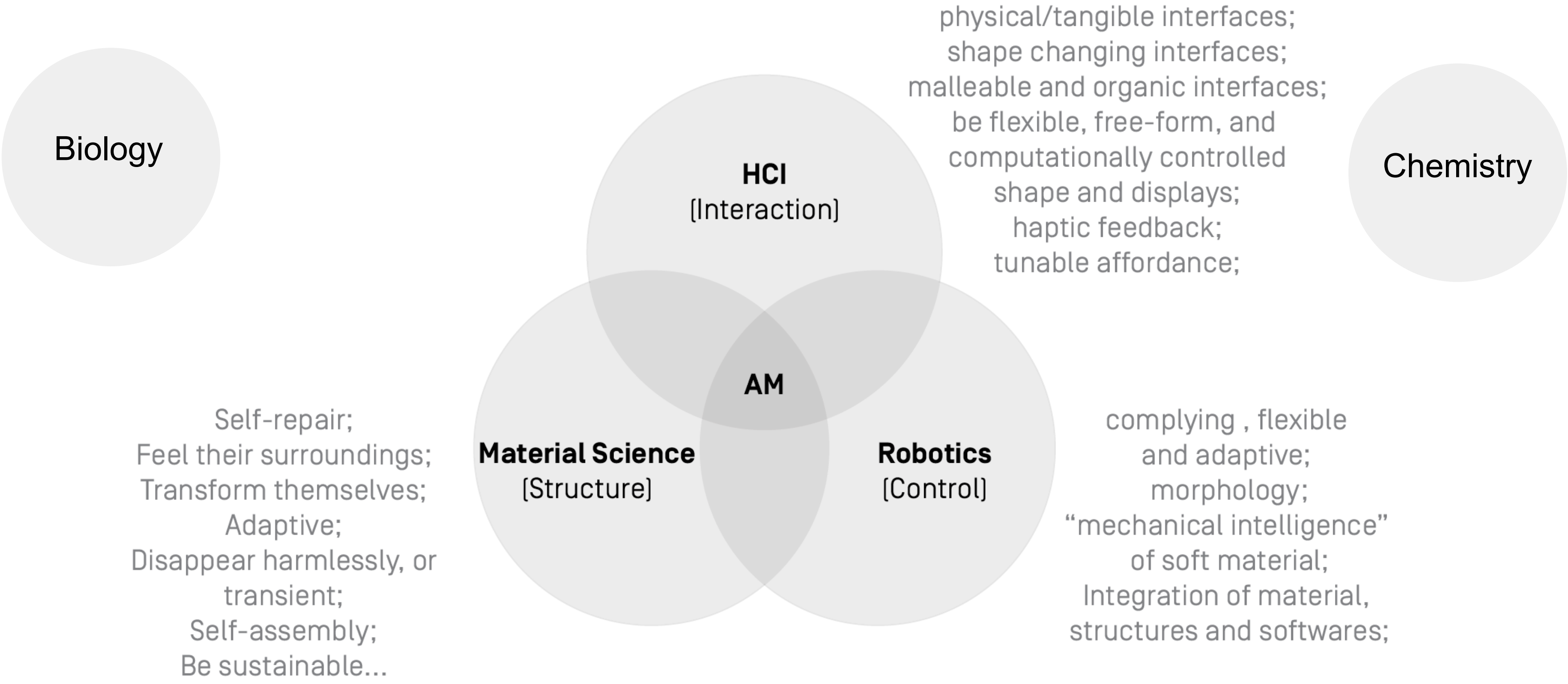
physical/tangible interfaces;
shape changing interfaces;
malleable and organic interfaces;
be flexible, free-form, and
computationally controlled
shape and displays;
haptic feedback;
tunable affordance;



Self-repair;
Feel their surroundings;
Transform themselves;
Adaptive;
Disappear harmlessly, or
transient;
Self-assembly;
Be sustainable...

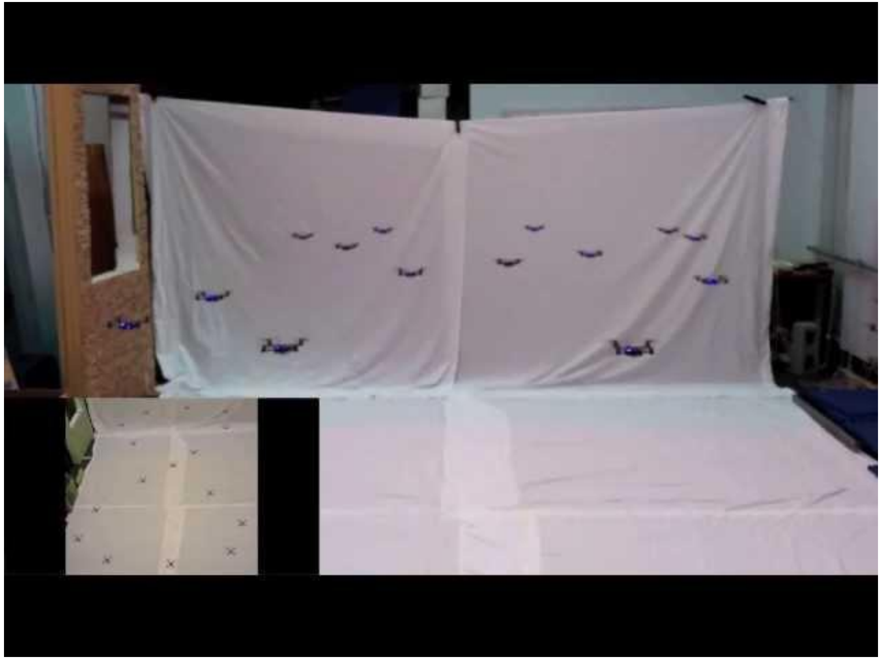
complying , flexible
and adaptive;
morphology;
“mechanical intelligence”
of soft material;
Integration of material,
structures and softwares;

Multidisciplinary Background - 2014

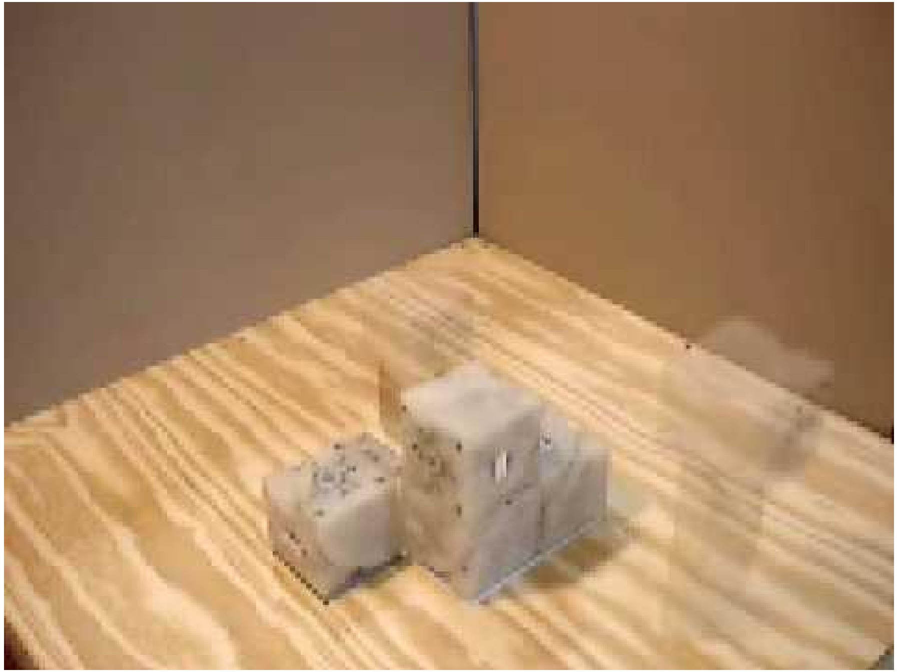


Robotics
(Hard Mechanism)

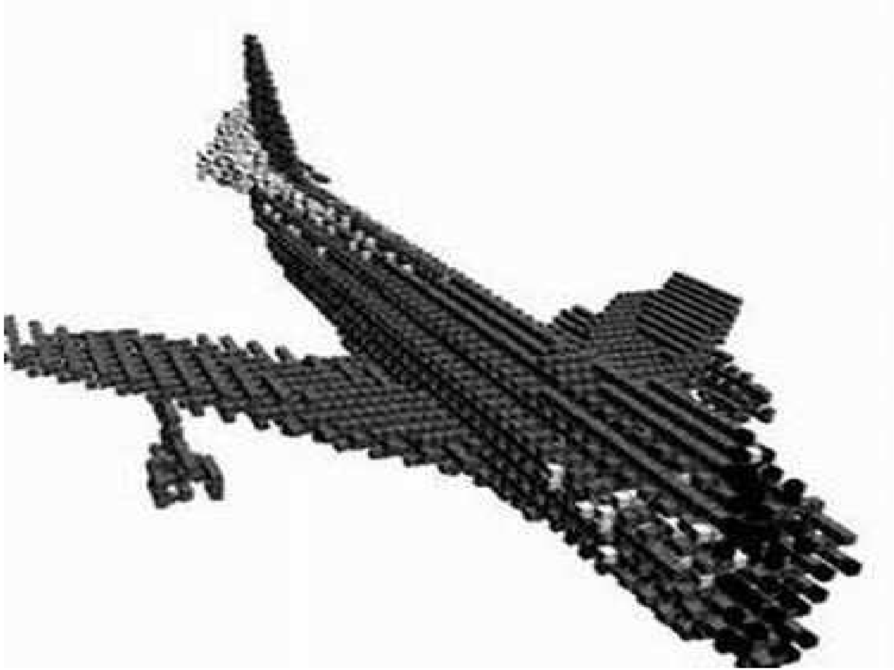
Swarm



Programmable Matter (Self-replicating, self-reconfigurable)



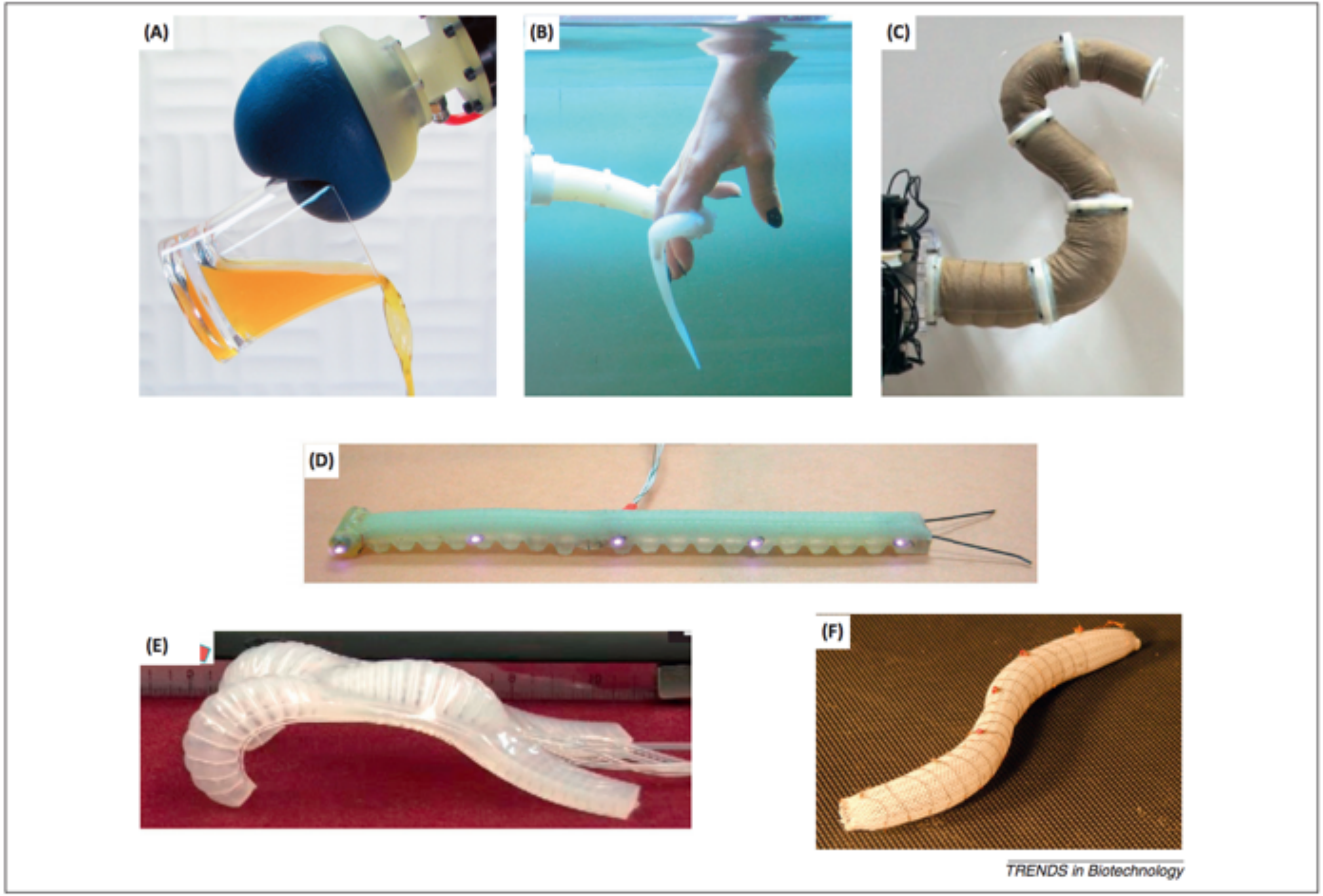
Hod Lipson. Creative Machine Lab



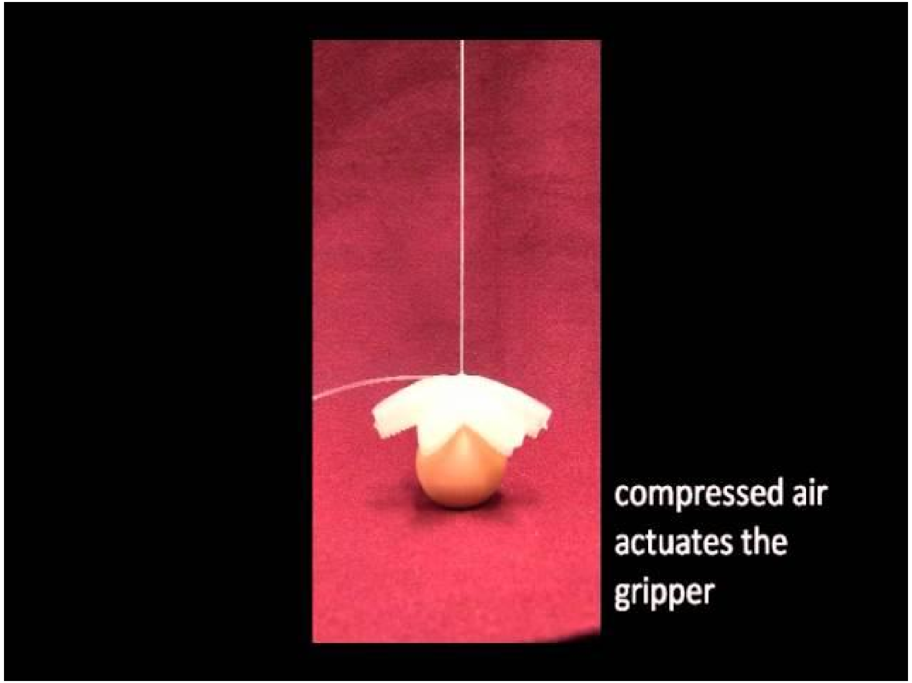
Modular Robotics Labs at The University of Southern Denmark

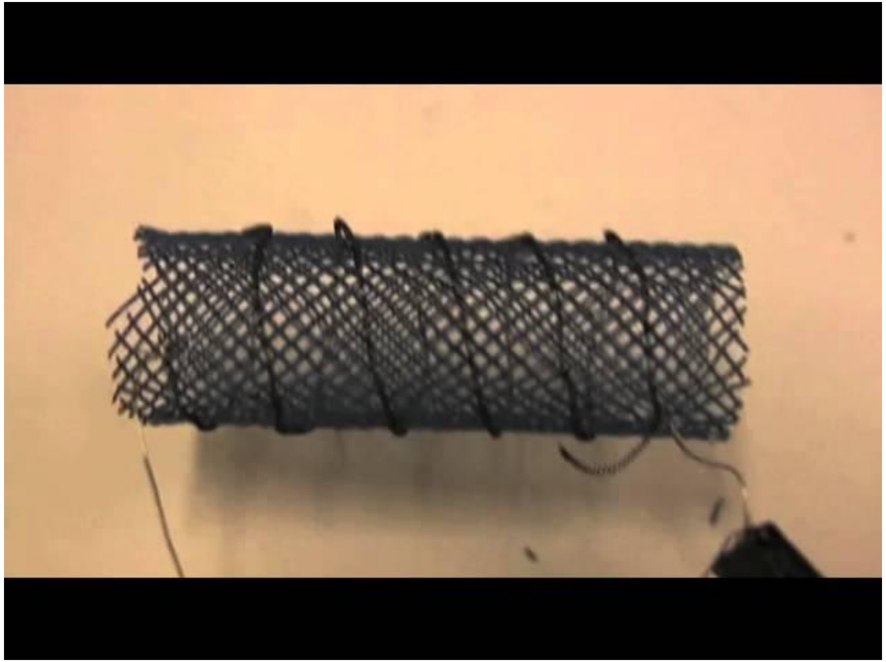
Linkage and Automata

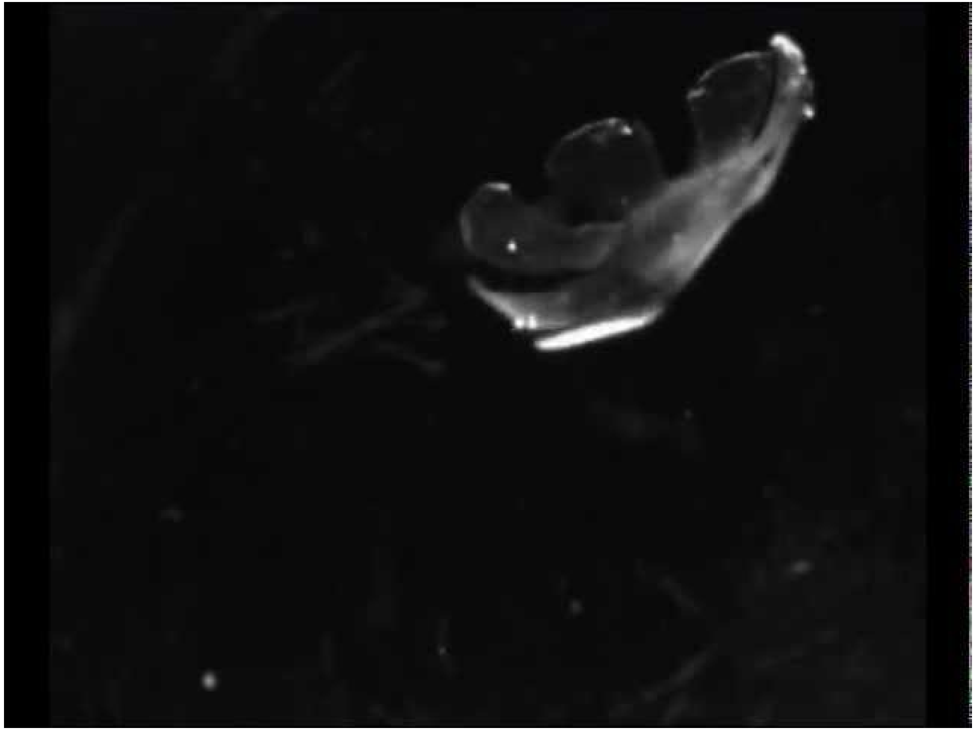
Robotics
(Soft Mechanism)



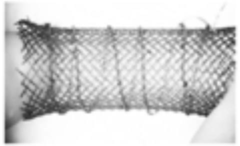
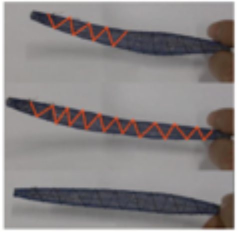
Kim, S., C. Laschi, and B. Trimmer, **"Soft robotics: a bioinspired evolution in robotics"**, *Trends in Biotechnology*, vol. 31, issue 5, pp. 287-294, 05/2013.


compressed air
actuates the
gripper

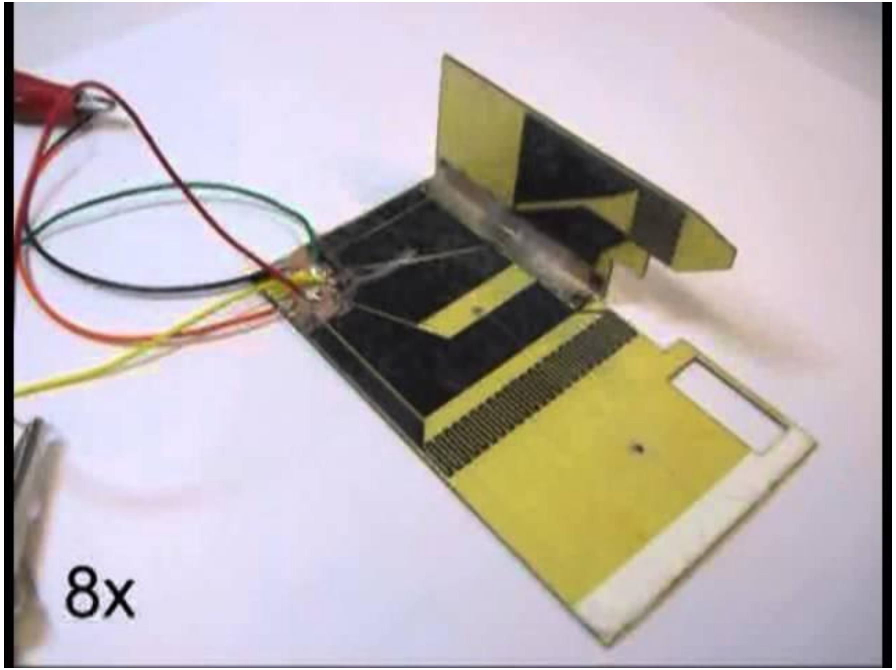


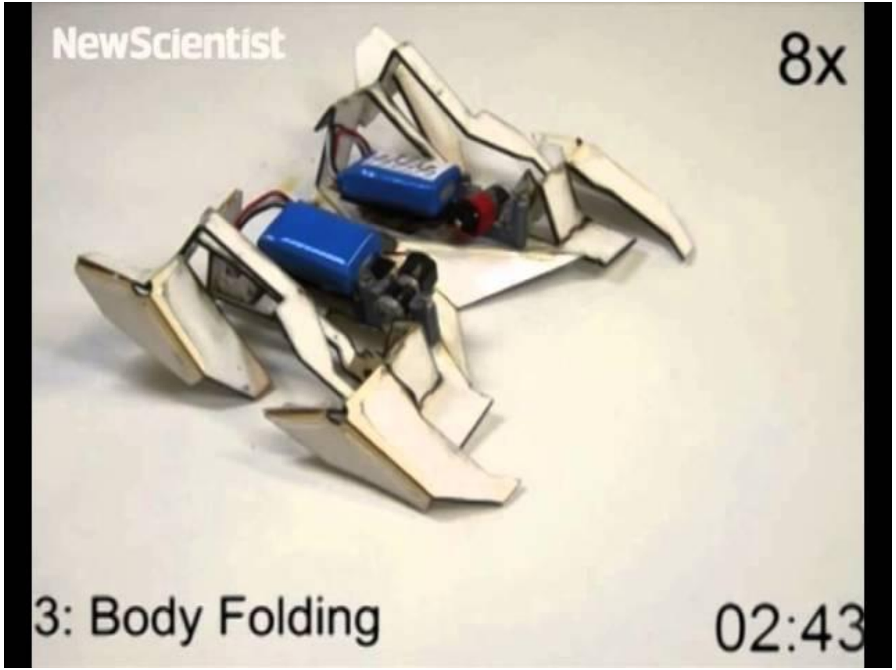


Note - Program Material Behavior

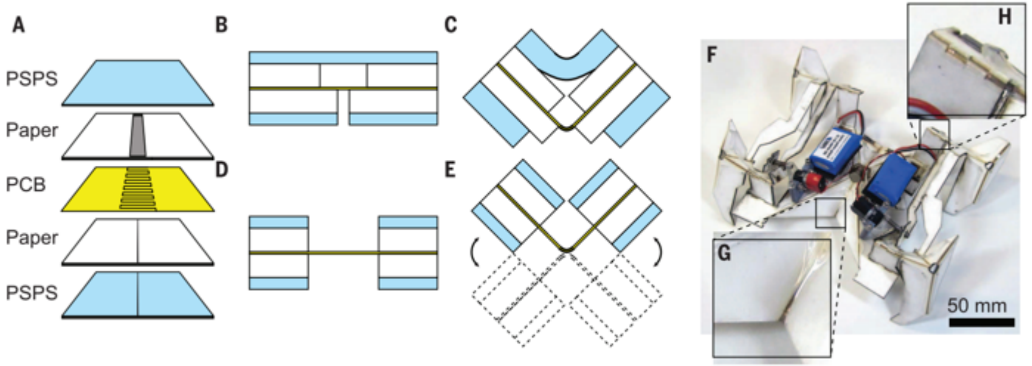
Applied Stimuli	Material Composition	Computation Principles	Material Geometry and Structure	Shape Change Output
Uniform Internal: Current	 3 sections of Nitinol coil annealed at different temperature: 370'C, 480'C and 630'C.	 Each segment expands and contracts at different current.		 Micro muscle robot[5]

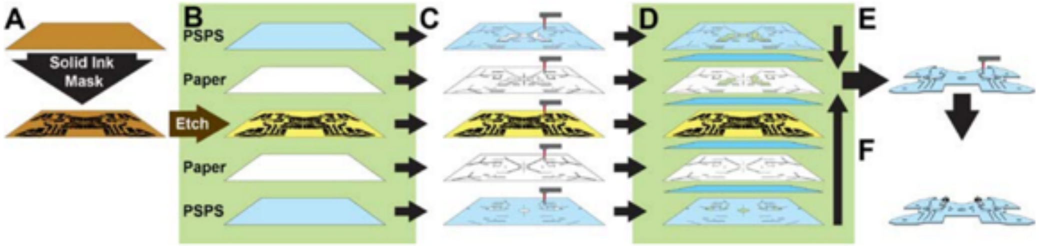
Robotics
(Folding and Linkages)


8x


NewScientist
8x
3: Body Folding
02:43

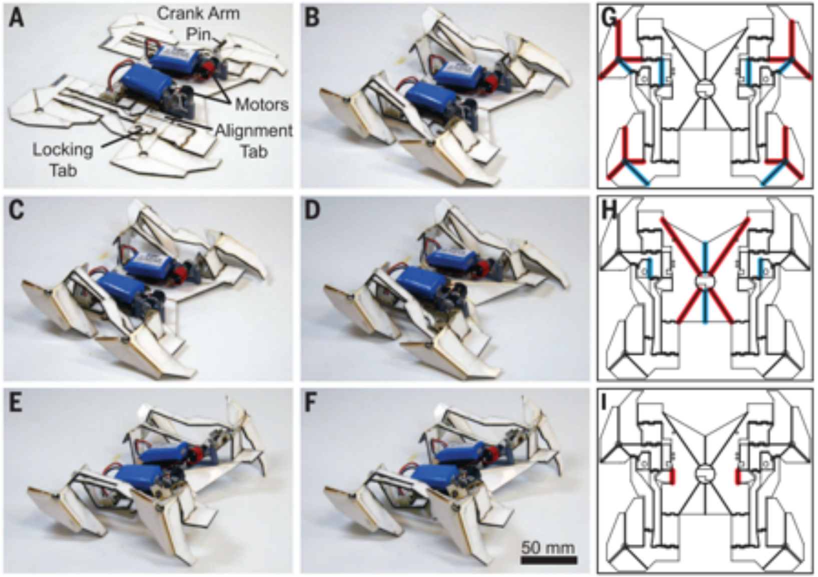
Note - Embedding control logic in fabrication

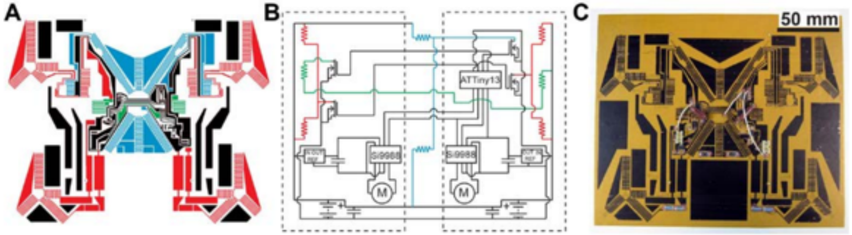




Science 8 August 2014:
Vol. 345 no. 6197 pp. 644-646

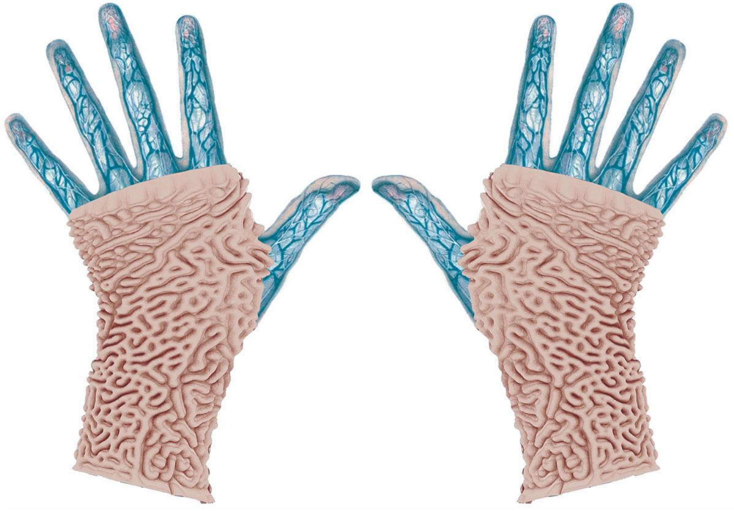
Note - Embedding control logic in control





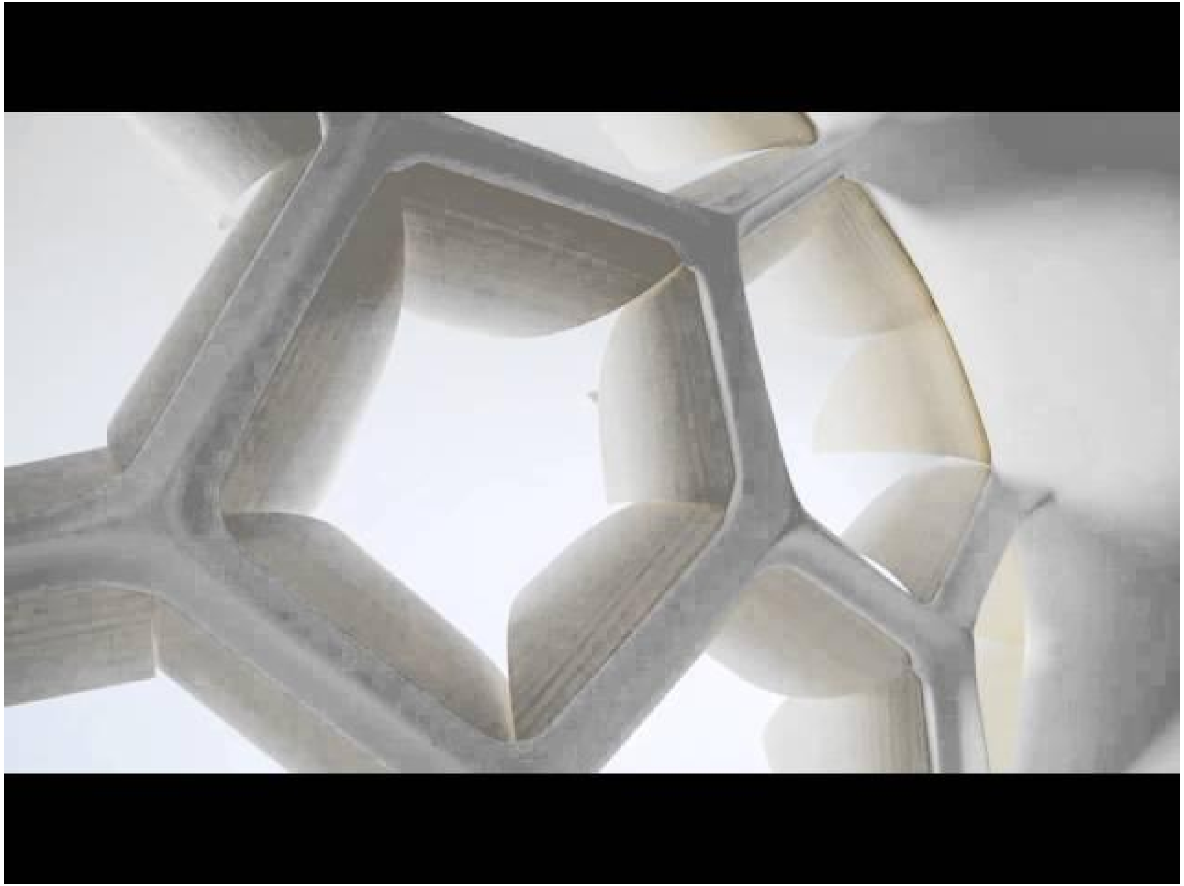
Science 8 August 2014:
Vol. 345 no. 6197 pp. 644-646

Design



Carpal Skin: Wrist Split

Neri Oxman



HygroSkin: Meteorosensitive Pavilion

Achim Menges
Oliver David Krieg
Steffen Reichert

Institute for Computational Design, Stuttgart

Shape-Shifting Wood, Carbon Fiber and Plastics Materials

Skylar Tibbits,
Self-Assembly Lab, MIT

Note - Design Anisotropy

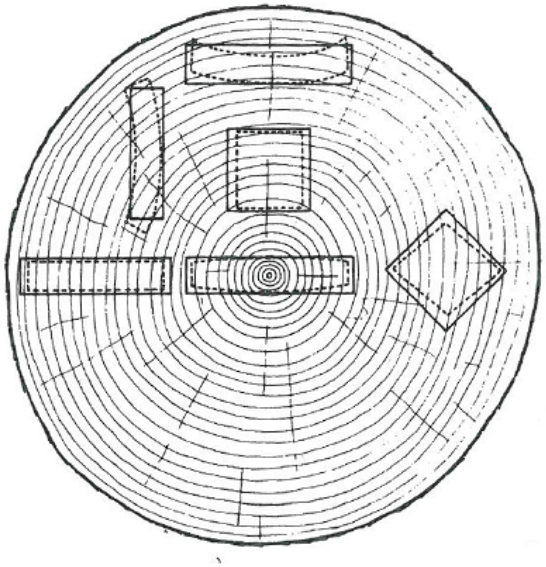


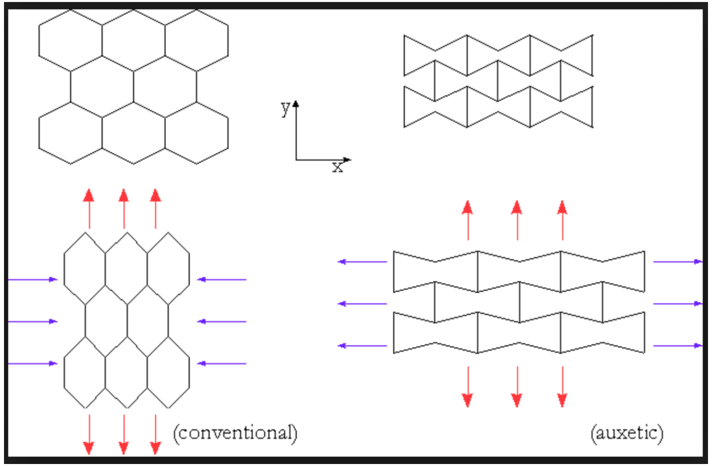
Figure 16. Diagram of a transverse section through a tree trunk illustrating the deformations that result when blocks of secondary xylem (wood) are taken out and allowed to try. the in situ geometry of each block of wood is shown by solid lines; the bent outline of each block, once it is removed from its original location, is shown by dotted lines

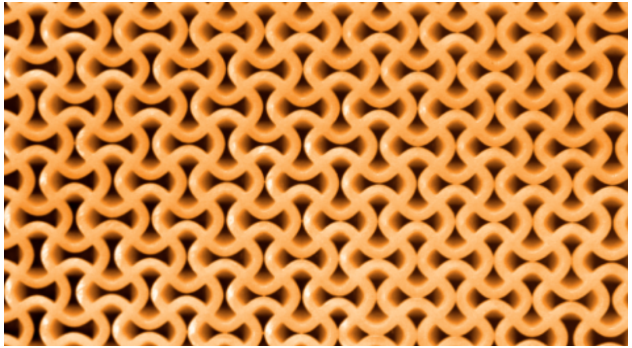
Nature creates function and transformation by combining pre-defined structure and passive force. The heterogeneous distribution of material (a pre-defined structure) gives us the opportunity to shift the controllability from the external forces to the material construction.

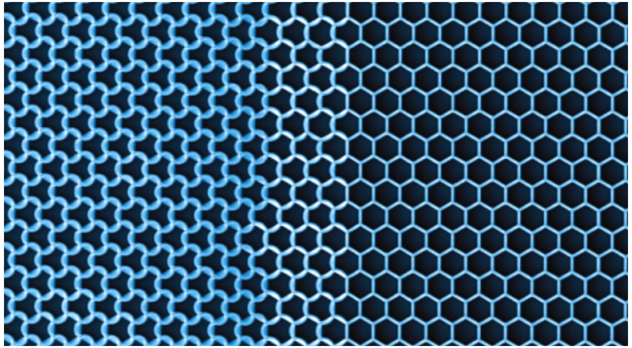
Material Science

The Bertoldi Group @ Harvard

understanding the non-linear response of materials and structures.





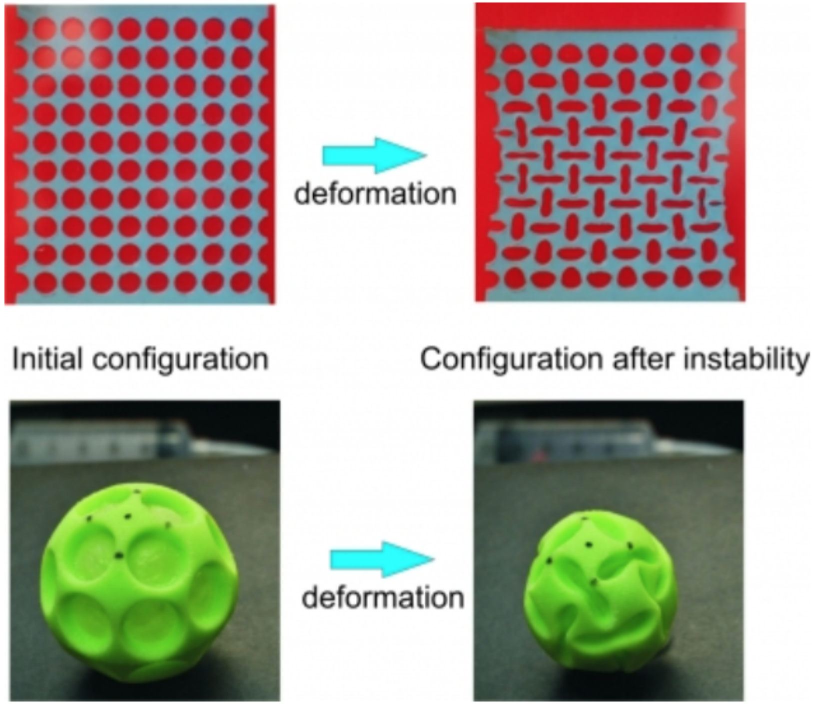


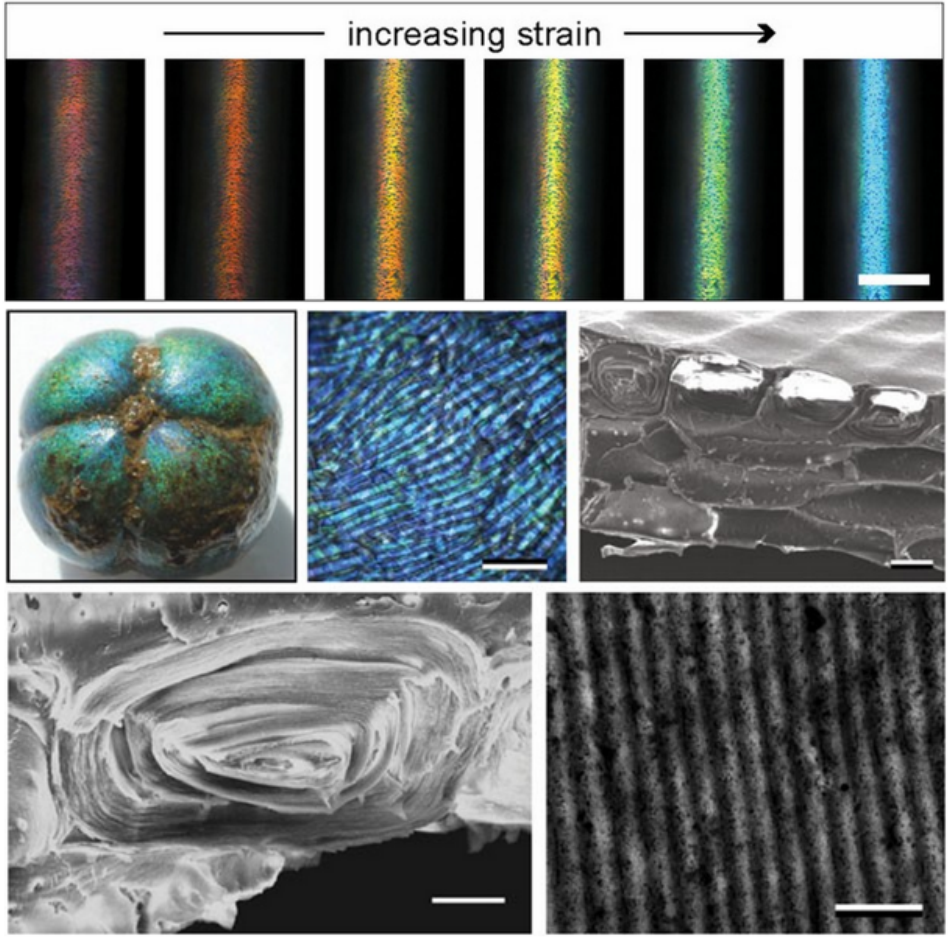
Note: Structures design of soft material such as elastomer.The careful design may lead to materials with unusual properties such as negative Poisson's ratio. can be used for soft robot design.

Other application: tunable phononic crystals; color display; complex structures.

they have been using extensively computer simulation before fabrication.

The Bertoldi Group @ Harvard

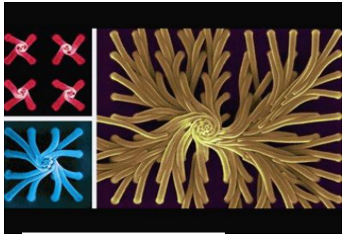




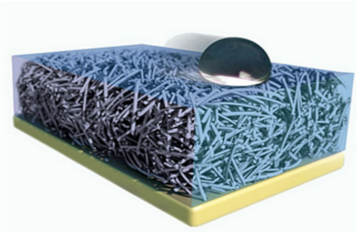
Bio-inspired Optics: color-tunable photonic fiber

Mathias Kolle
Alfred Lethbridge
Moritz Kreysing
Jeremy J. Baumberg
Joanna Aizenberg
Peter Vukusic

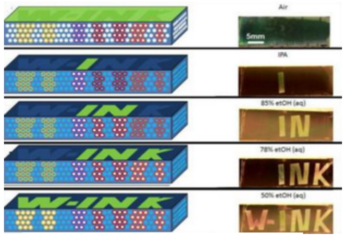
Note - Shape Across Scales



nano-fiber self assembly



SLIP: bio-inspired slippery surface

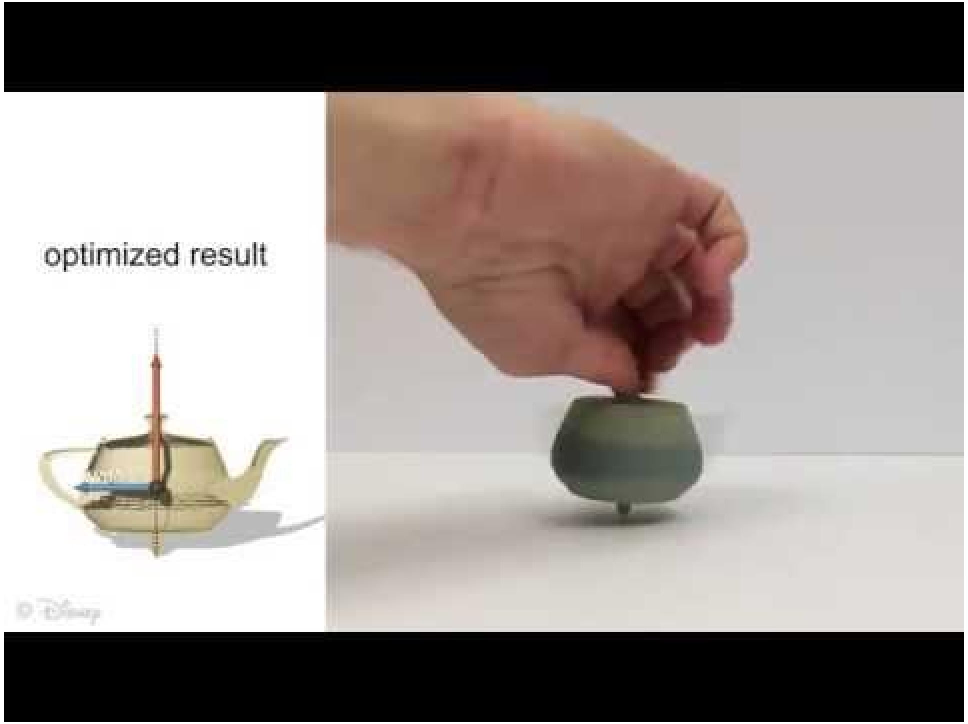


Wetting in color (W-ink)

Mechano-Responsive Optical Material

Shape at the invisible scales creates functions, properties of a material.

Computational Fabrication



Spin-It: Optimizing Moment of Inertia for Spinnable Objects

Moritz Baecher (Disney Research Zürich)
Emily Whiting (ETH Zürich)
Bernd Bickel (Disney Research Zürich)
Olga Sorkine-Hornung (ETH Zürich)

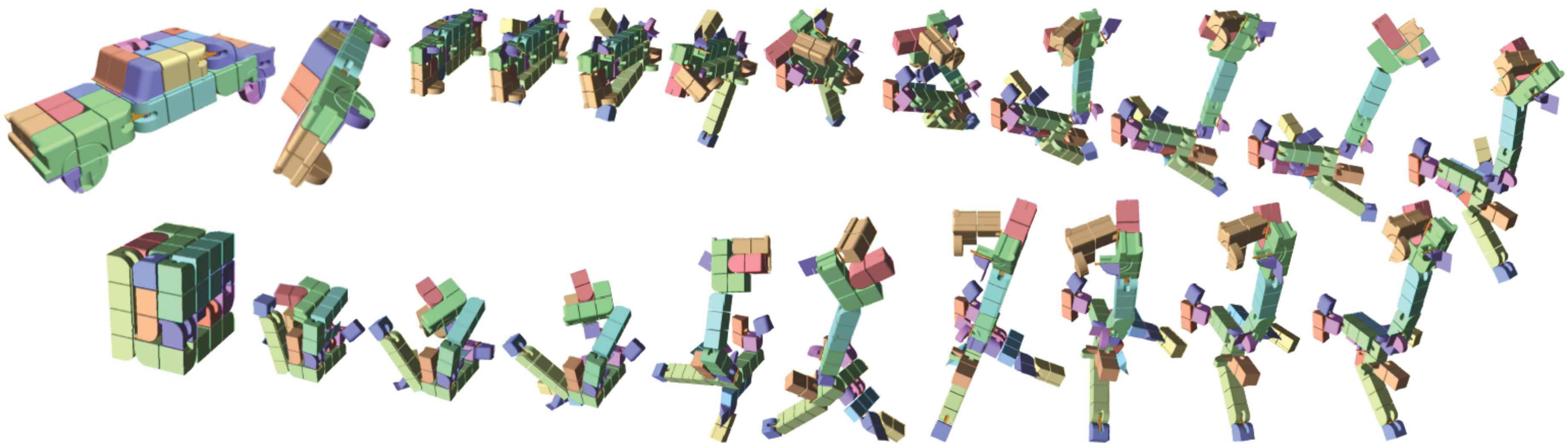
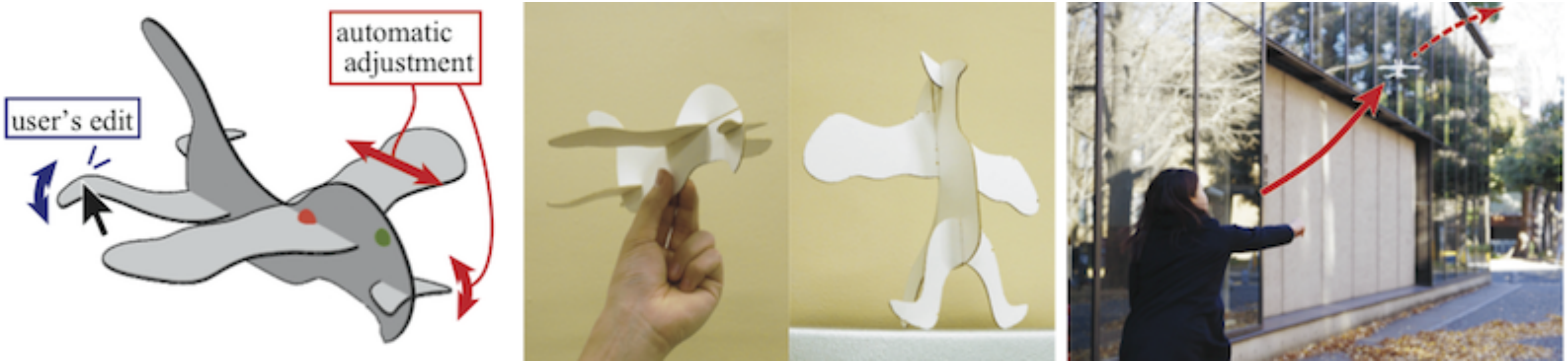


Figure 1: *Folding a car into a cube. Our system finds a collision-free folding sequence.*

Boxelization: Folding 3D Objects into Boxes

Yahan Zhou (Disney Research Boston)
Shinjiro Sueda (Disney Research Boston)
Wojciech Matusik (Massachusetts Institute of Technology)
Ariel Shamir (Disney Research Boston/The Interdisciplinary Center, Herzelia, Israel)



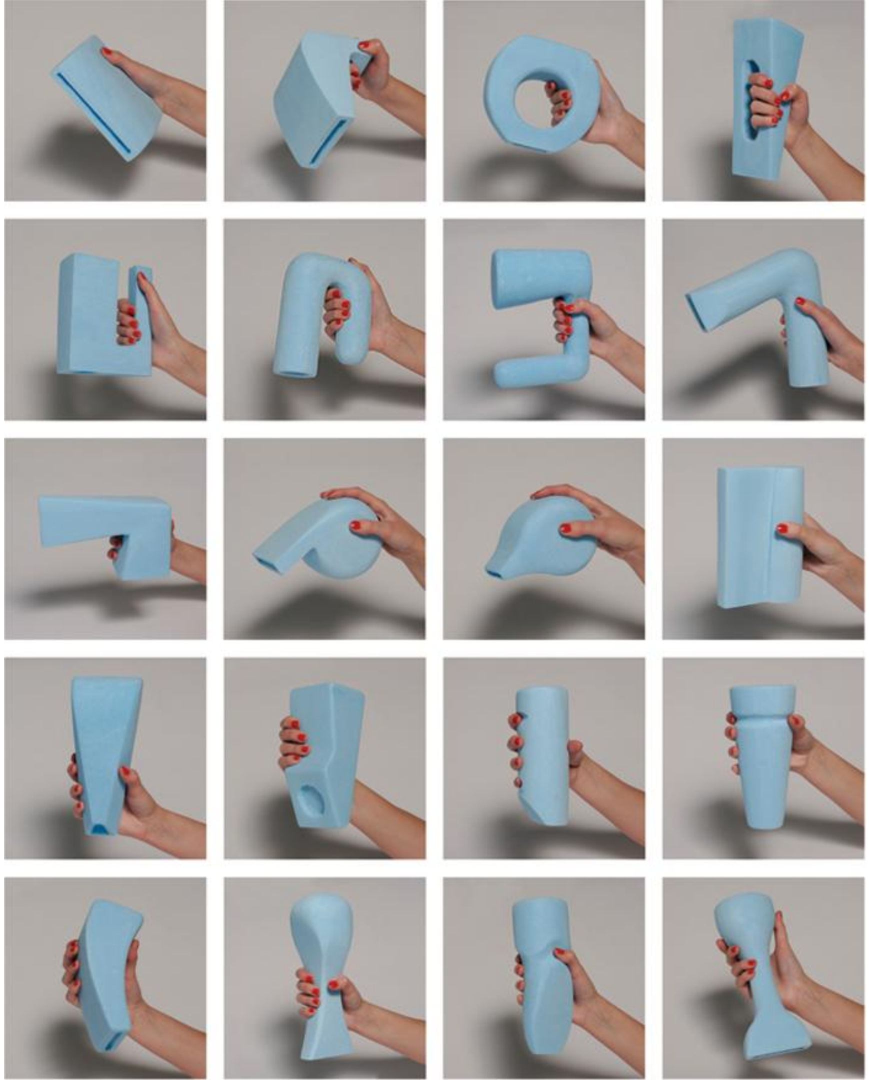
Pteromys: Interactive Design and Optimization of Free-formed Free-flight Model Airplanes

Nobuyuki Umetani
Yuki Koyama
Ryan Schmidt
Takeo Igarashi

Note - From Property to Materiality

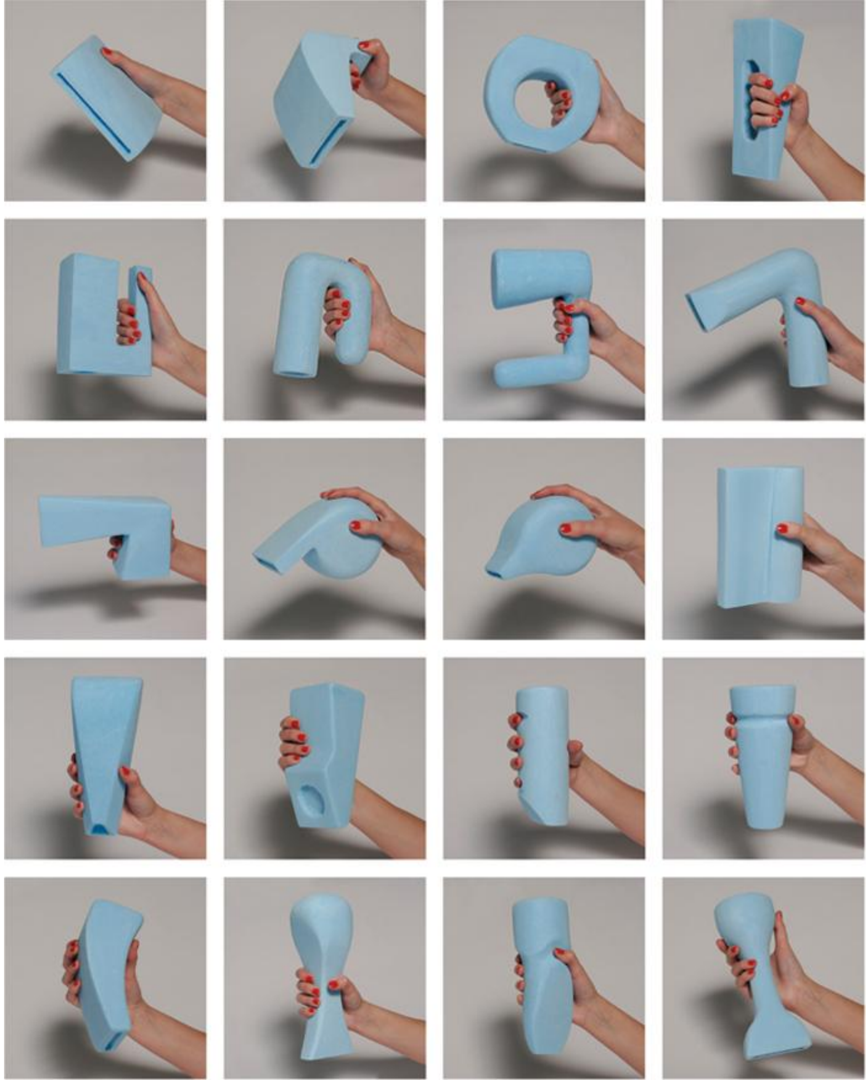
Objects that seem impossible in the physical world.

How?
Fabrication problem.
Mechanical and electrical engineering problem.
Material science problem.
Biological and chemical science problem.
Why?
Interaction problem.
Design and psychology problem.



Shape as media to

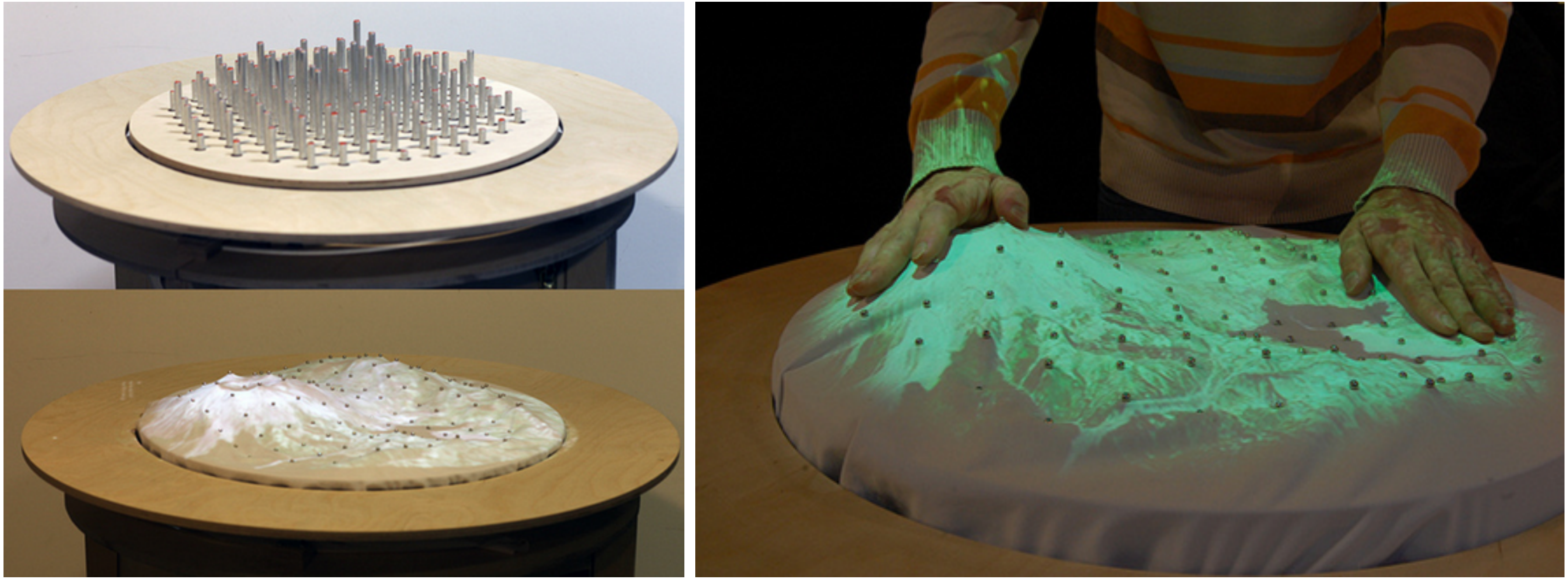
afford interaction
create function
inform meaning
represent information



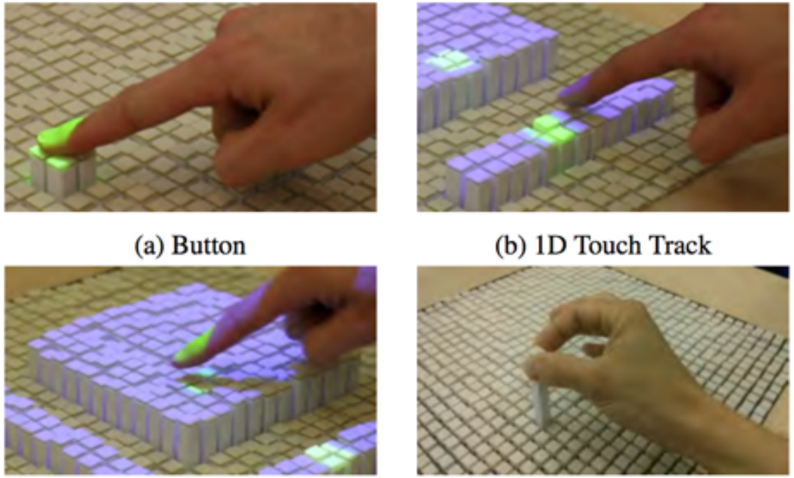
Shape as media to **dynamically**

represent information
afford interaction
create function
inform meaning

Represent information

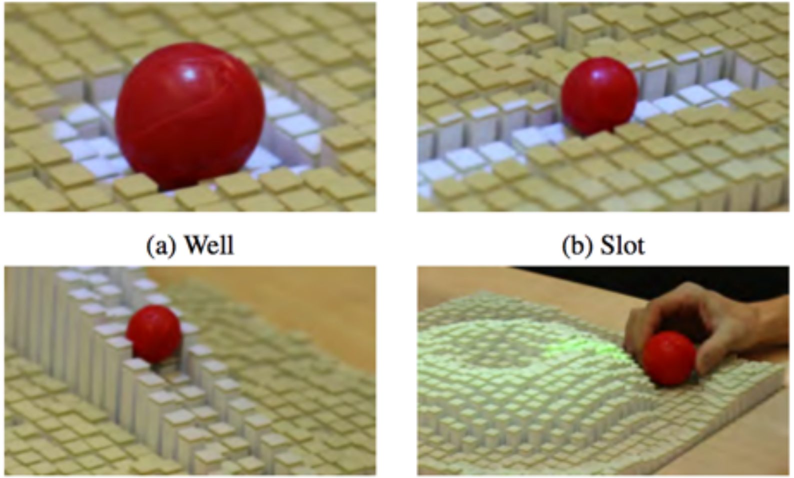


Afford Interaction



(a) Button (b) 1D Touch Track (c) 2D Touch Surface (d) Handle

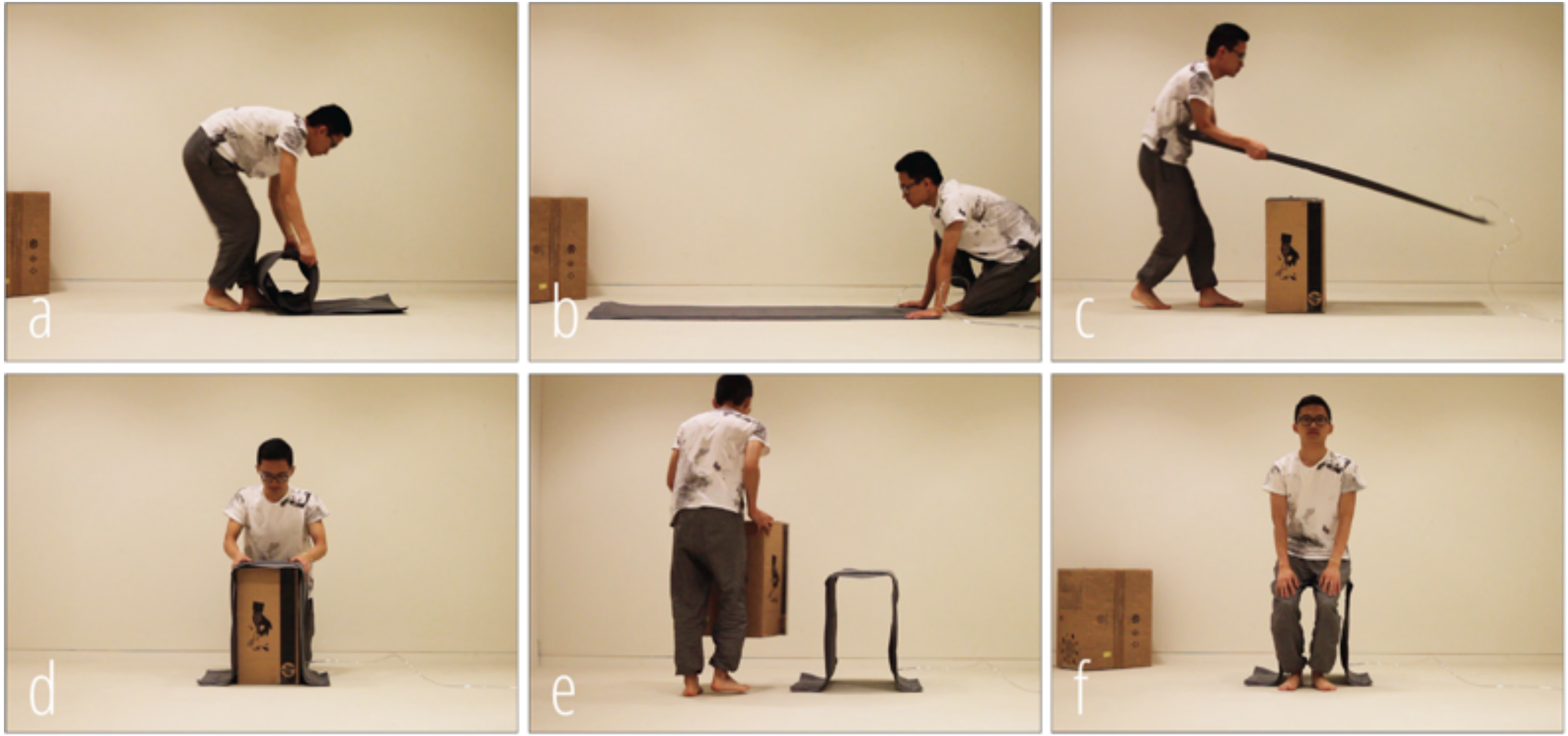
Figure 2: *Dynamic Physical Affordances* transform the UI to facilitate interactions.



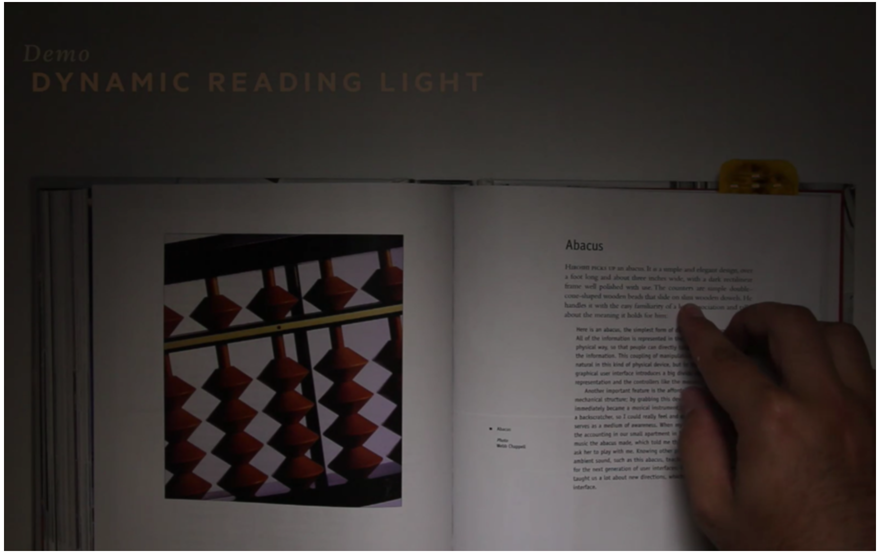
(a) Well (b) Slot (c) Ramp (d) Surface

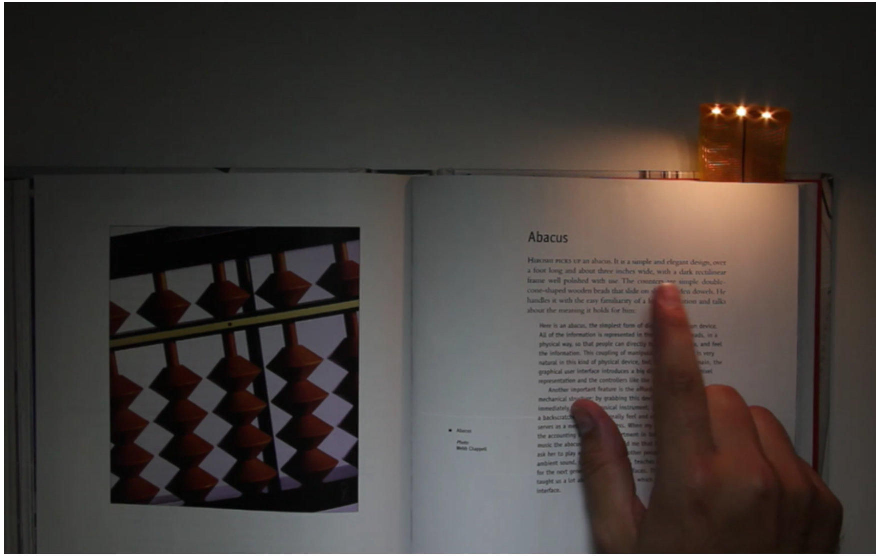
Figure 3: *Dynamic Physical Constraints* guides the user by limiting possible interactions.

Create Function

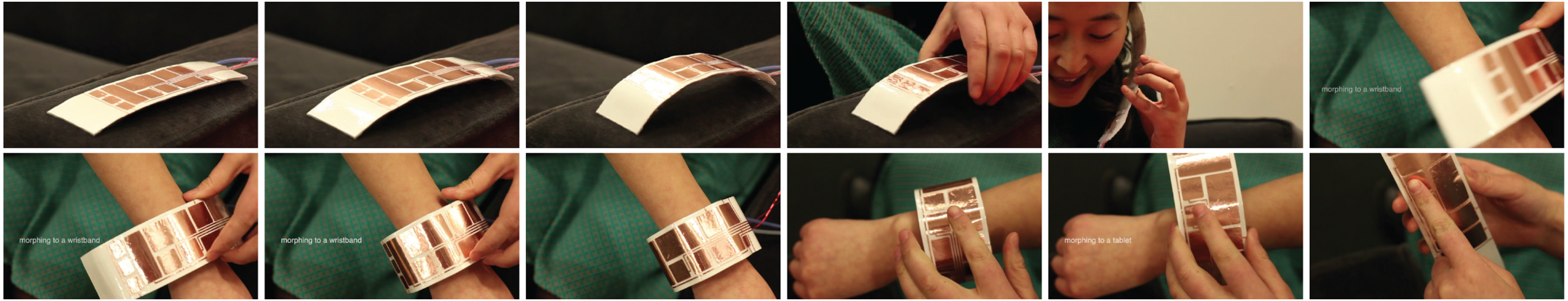


Create Function





Inform Meaning



Shape as media to **dynamically**

represent information
afford interaction
create function
inform meaning

Shape as Media