

FUNCTION FOLDS IN

A soft robot changes gait by folding. Heater traces become a fabrication language, fabric reads muscle through air, stacked touch separates pressure from temperature, and light rewrites polymer form. Capability moves closer to the body of the object.



INTEGRATED PHYSICAL
INTELLIGENCE

When geometry, material, and fabrication carry more of the logic, adaptation can arrive with less interface overhead.

01



A Nature Communications study presents a six-spoke elastomer robot with embedded liquid-metal channels that uses Laplace forces in a static magnetic field. The small soft body switches among more than nine locomotion modes in under 0.35 seconds, including rolling at 818 millimeters per second, or 26 body lengths per second, crawling, jumping, and swimming. Folding reduces its occupied volume by 79%, and the team tested navigation across obstacles, gelatin, viscous fluid, a printed stomach surface, and a porcine stomach. These are controlled demonstrations toward biomedical use, not evidence of autonomous clinical operation.

A QUESTION FOR DESIGN

**ONE BODY
FINDS NINE
WAYS**

Could one compliant body resolve transitions between modes through its own geometry, while making the limits of external actuation and control legible? ^{*1}

02



HeaTrace joins heater geometry, a physics-informed thermal model, and fabrication-ready toolpaths for direct ink writing and automated fiber embedding. Tests on silicone with stainless-steel yarn heaters covered 5–15 watts, durability, inflation, and stiffness modulation. The workflow produced a gecko-inspired robot with a 6.5-gram thermally driven shape-change actuator, a fin with 14% stroke asymmetry, and a face that blushes. It is a research workflow rather than a general manufacturing standard, but it makes the conductive path part of the authored behavior instead of an afterthought.

A QUESTION FOR DESIGN

THE TRACE PROGRAMS THE BODY

Could a fabrication trace become a readable behavioral specification, letting designers tune heat, motion, and compliance in one workflow? ^{*2}

03



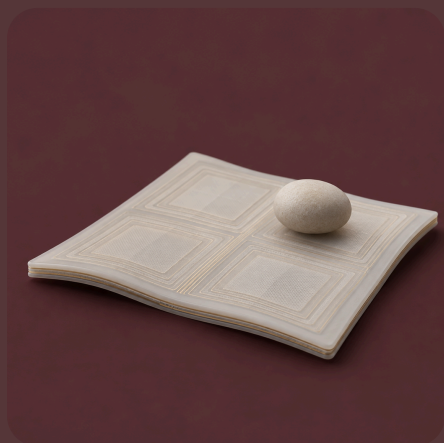
Researchers built a wearable force-myography system from a thermoplastic-polyurethane-coated nylon chamber whose internal honeycomb support converts muscle deformation into air-pressure change. With no electronics at the sensing site, the textile chamber tolerated controlled lateral offsets and, in a preliminary comparison, tracked surface electromyography at $r = 0.89$. Tests with 16 participants across three body sites and four tasks produced within-session classification accuracy of 75.8–85.4% and an R^2 of 0.890 for elbow tracking; cross-person performance varied by task. The evidence supports feasibility, not universal decoding.

FABRIC READS MUSCLE THROUGH AIR

A QUESTION FOR DESIGN

Could moving transduction into a soft pneumatic structure improve fit and serviceability without hiding where calibration still belongs to each wearer? ^{*3}

04



A soft tactile interface combines a three-dimensionally stacked capacitive pressure sensor with a reduced-graphene-oxide temperature sensor inside the same pixel area. Buried interdigitated and parallel-plate capacitors increase baseline capacitance in a smaller footprint, while a via-free interlayer connection addresses array wiring. Independent transduction layers let the prototype map contact geometry and local temperature with limited cross-interference, including during robotic scanning when vision is constrained. The paper establishes a laboratory sensing architecture, not production reliability in a deployed hand.

A QUESTION FOR DESIGN

TOUCH STACKS ITS SENSES

Can a layered surface add modalities without passing their wiring, calibration, and cross-talk complexity into the robot's higher-level interface? ^{*4}

05



ACS researchers compared regioregular polyolefin-like homopolymers carrying azobenzene groups at fixed intervals with regiorandom analogues. Under ultraviolet light, assemblies of the precision polymers shifted from nanospheres into one- and two-dimensional forms; visible light restored the initial morphology. The random copolymers followed a different three-dimensional transformation and recovery path. This is nanoscale self-assembly, not yet a macroscopic actuator, but it shows how molecular spacing can predefine the directions available to later shape change.

A QUESTION FOR DESIGN

LIGHT REWRITES THE ASSEMBLY

Could the placement of responsive units constrain adaptation into a few useful, reversible states instead of requiring a more elaborate control layer? ^{*5}

AUXETIC LENS

EXPAND WITHOUT ADDING WEIGHT.

The useful future is not the one with the most technology. It is the one that adapts without transferring its complexity to the person.

01

Which behaviors become calmer when geometry and fabrication define the available moves before software chooses among them?

02

How can a product expose the boundaries of material intelligence—external fields, heat, calibration, fatigue—without transferring its operation to the user?

03

When several sensing or actuation roles occupy one body, which layers must remain separable for repair, trust, and reuse?

04

Could constrained reversibility be more humane than unlimited configurability when the object itself carries the adaptation?

SOURCES

Images: editorial illustrations, not prototype photography.

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- *1** DOI.ORG / 2026-09-21T06:43:49Z
A FOLDABLE SMALL-SCALE SOFT ELECTROMAGNETIC ROBOT FOR MULTIMODAL NAVIGATION IN CONFINED AND UNSTRUCTURED ENVIRONMENTS

[Open source ↗](#)

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- *2** DOI.ORG / 2026-09-21T07:51:55Z
HEATRACE: A PARAMETRIC DESIGN-TO-FABRICATION WORKFLOW FOR THERMALLY PROGRAMMABLE SOFT ROBOTS

[Open source ↗](#)

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- *3** DOI.ORG / 2026-09-21T07:34:08Z
AN INTEGRATED FABRIC-PNEUMATIC SOFT SENSING SYSTEM FOR MULTI-SITE MUSCLE ACTIVITY DECODING

[Open source ↗](#)

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- *4** DOI.ORG / 2026-09-21T00:01:24Z
HIGH-SPATIOTEMPORAL AND MULTIMODAL SOFT TACTILE INTERFACE WITH LAYERED ARCHITECTURE FOR SIMULTANEOUS STRUCTURAL AND THERMAL PERCEPTION

[Open source ↗](#)

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- *5** DOI.ORG / 2026-09-21T08:01:55Z
LIGHT-TRIGGERED RAPID AND REVERSIBLE SHAPE TRANSFORMATION OF POLYOLEFIN-LIKE PRECISION AZO-HOMOPOLYMERS

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