

Memories of folding

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Assistant Professor, Physics

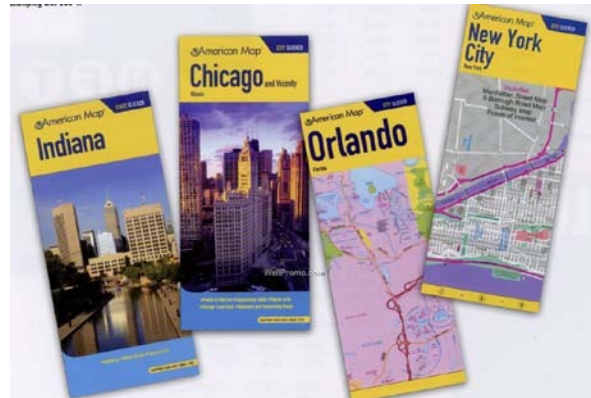
KITP Teacher's conference

Feb 17 2018



THE UNIVERSITY OF
CHICAGO

Folding a road map



How to fold a paper map

9,447 views

18 8 SHARE ...



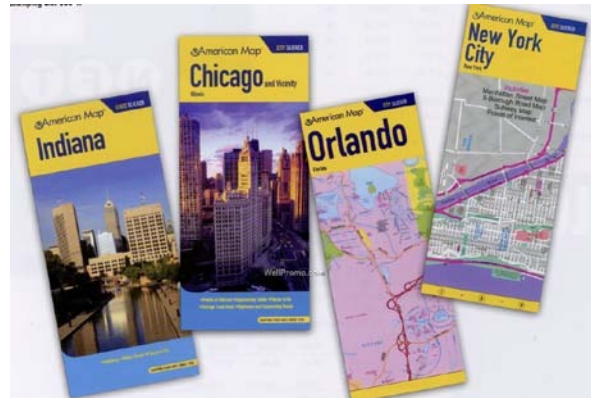
Ordnance Survey
Published on Feb 16, 2015

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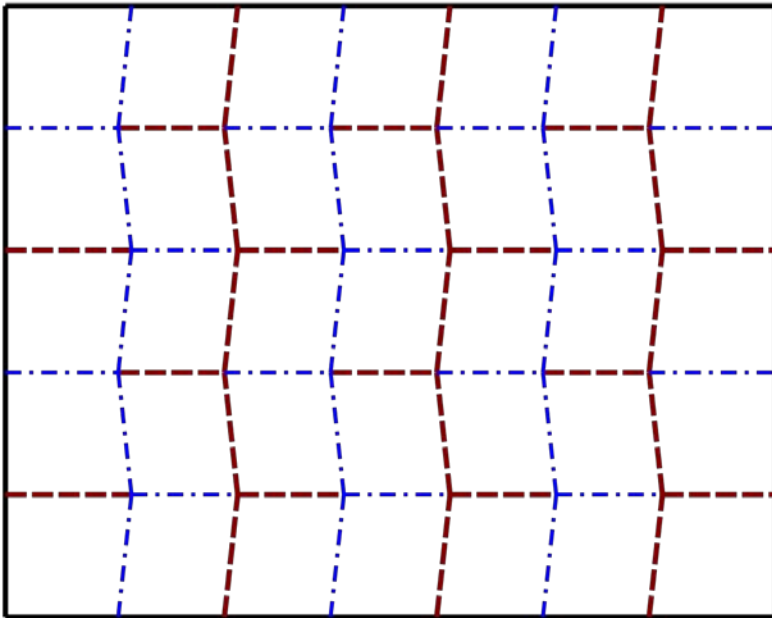
Adventurer Bonita Norris shows you how to fold an OS paper map in three simple steps
SHOW MORE

https://youtu.be/0qeeOeBf_KM?t=23

A self-folding road map



Miura Ori

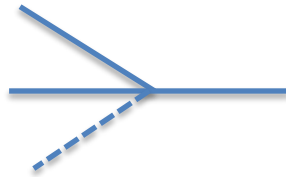


Demo: Single vertex

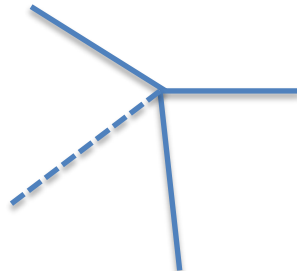
1. Two lines at right angles



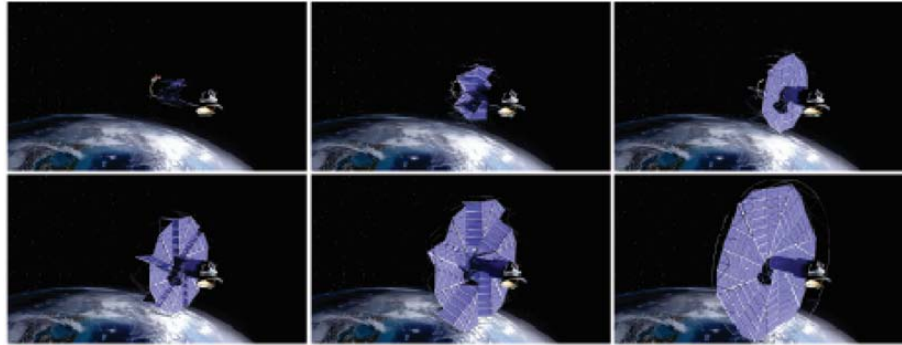
2. Two folds in sequence, not at right angles



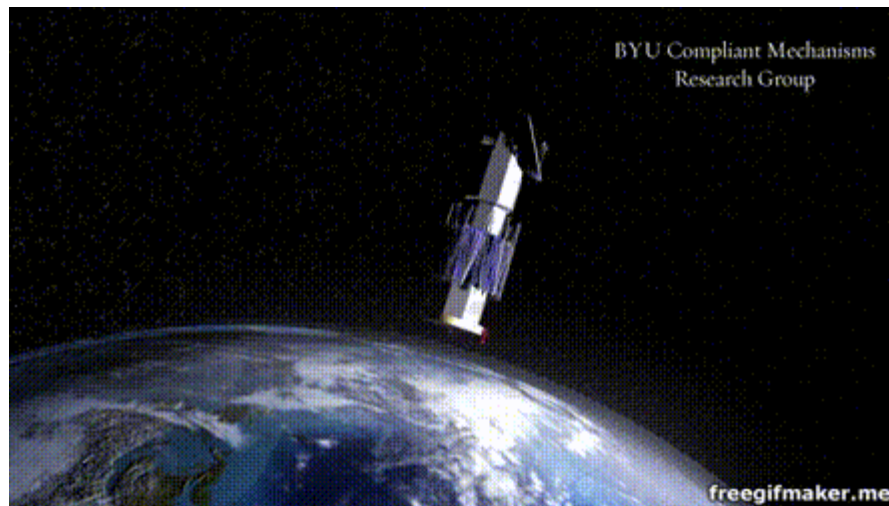
3. No straight lines



Self-folding origami in space

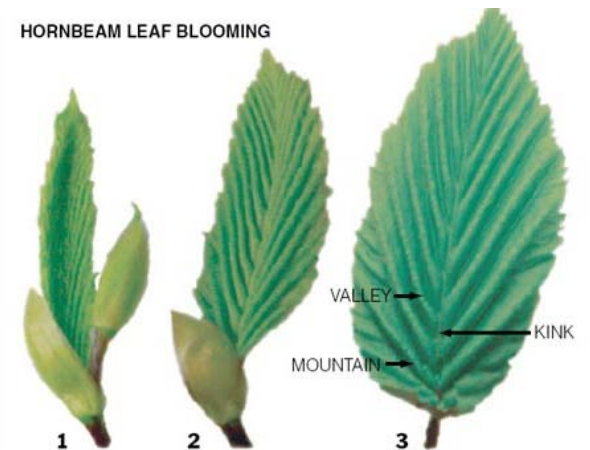


Not too hard
Not too soft



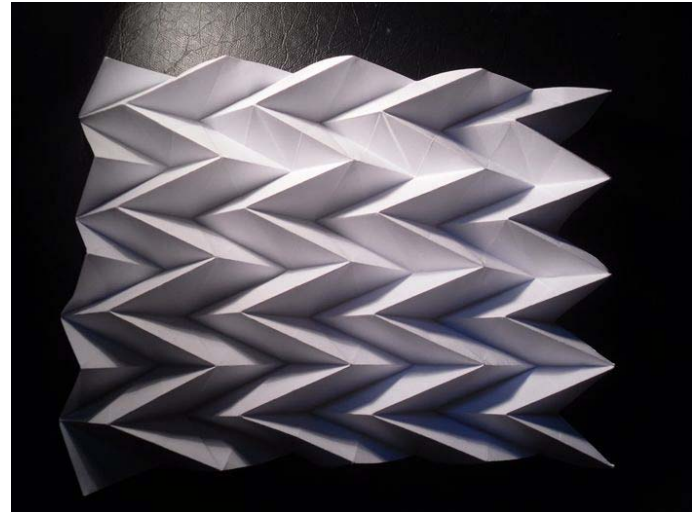
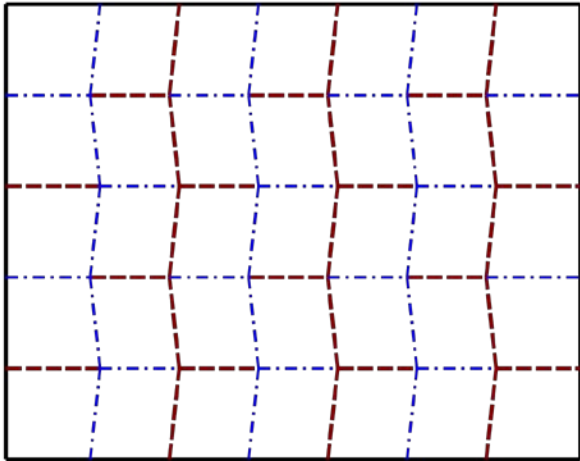
Goldilocks

Self-folding in the natural world





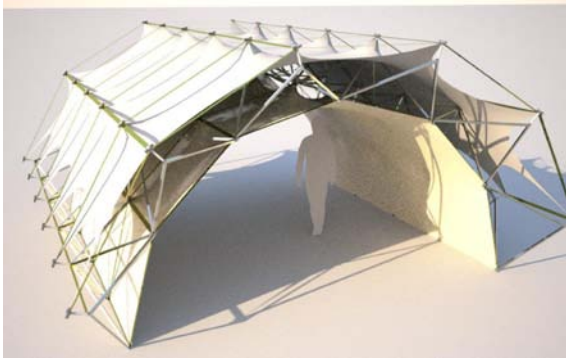
Fold Miura demo



<https://www.youtube.com/watch?v=uzx4dqCZnF0>

Works at any length scale

Daniel Piker



Deployable shelter

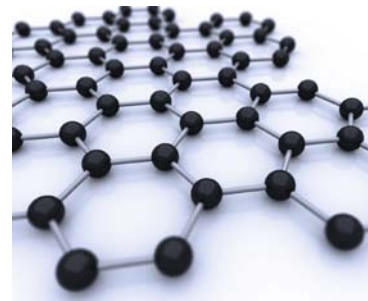
www.youtube.com/watch?v=IDUB6fW9q0
www.youtube.com/watch?v=dAkqeHMnh

Kuribayashi



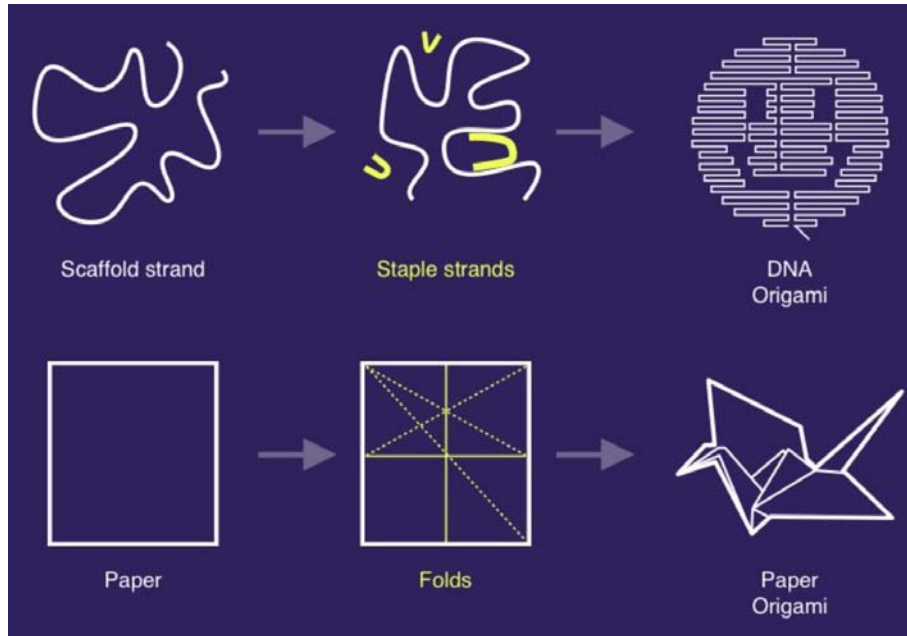
Heart stent

Cohen lab, Cornell

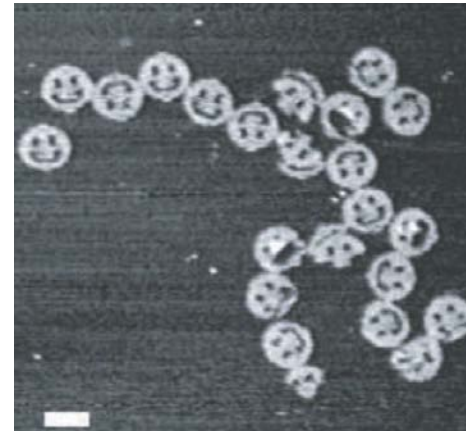
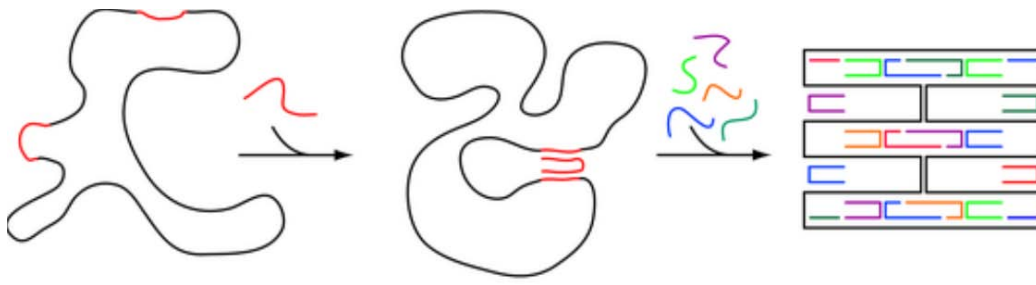


Graphene
Single layer of atoms

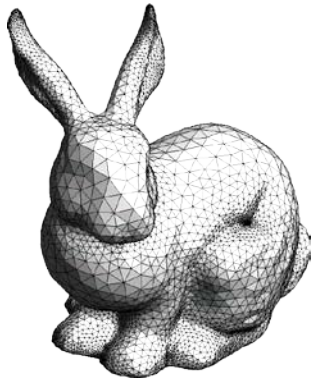
DNA Origami



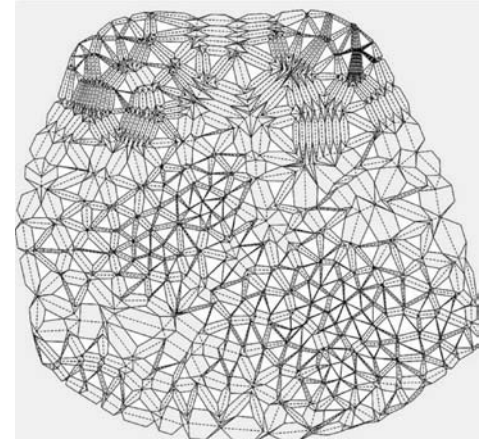
Each face ~ 70 nm
 ~ 1500 atoms wide



Shaping a sheet

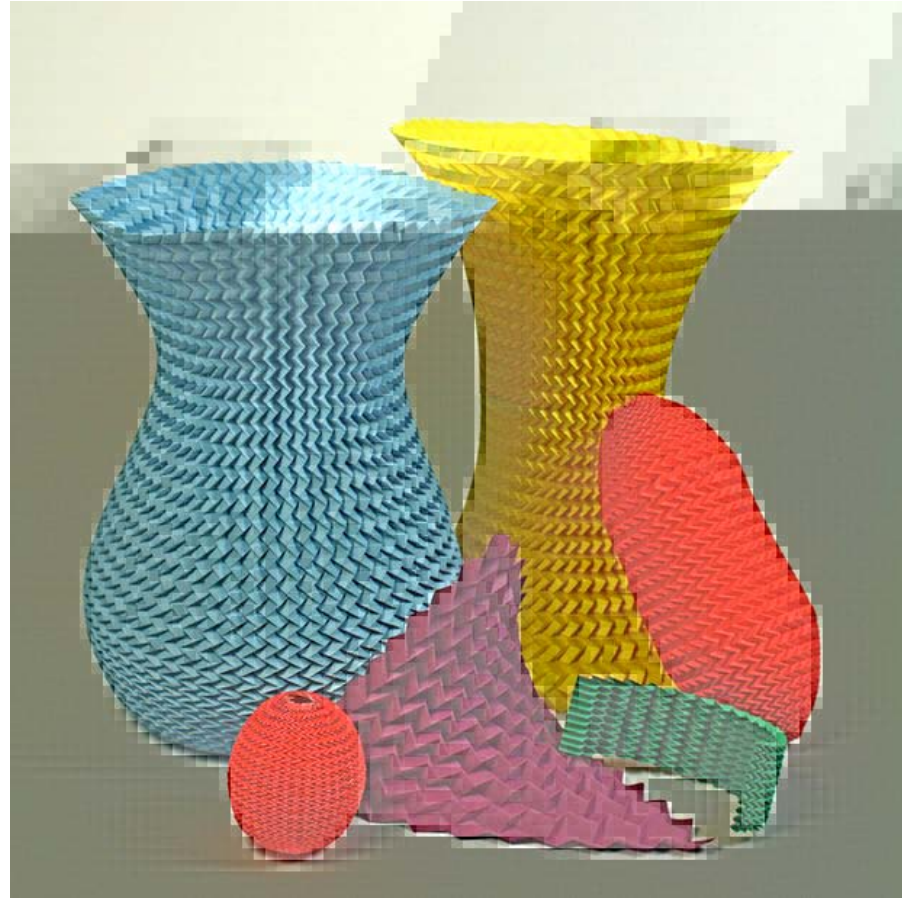
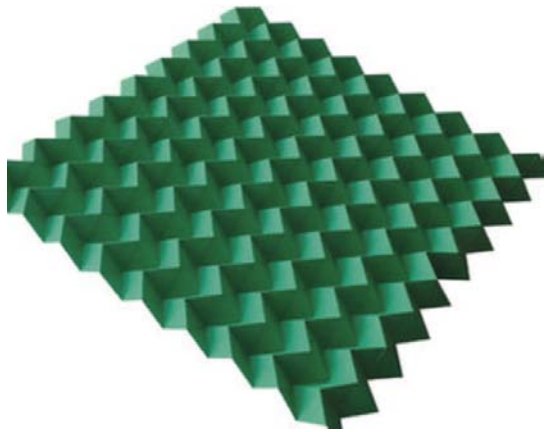


Tachi's Origamizer



~ 8 hours

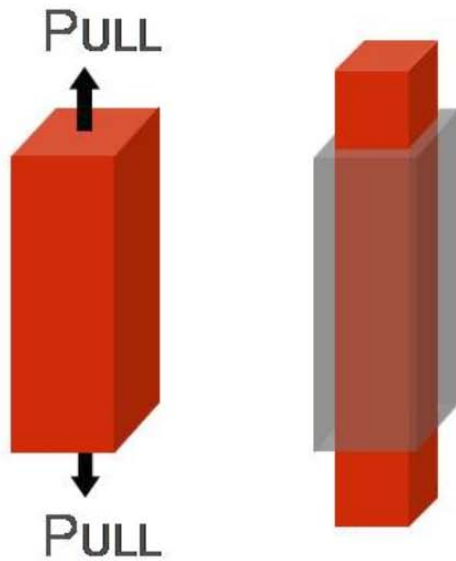
Shaping a sheet



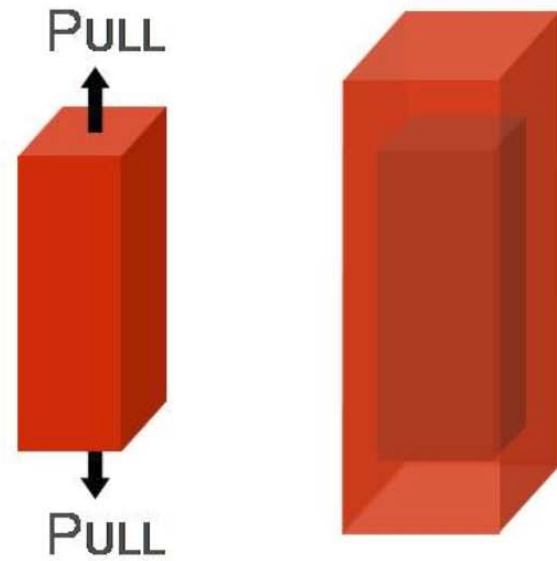
Mahadevan Lab/Harvard

An auxetic material

Conventional

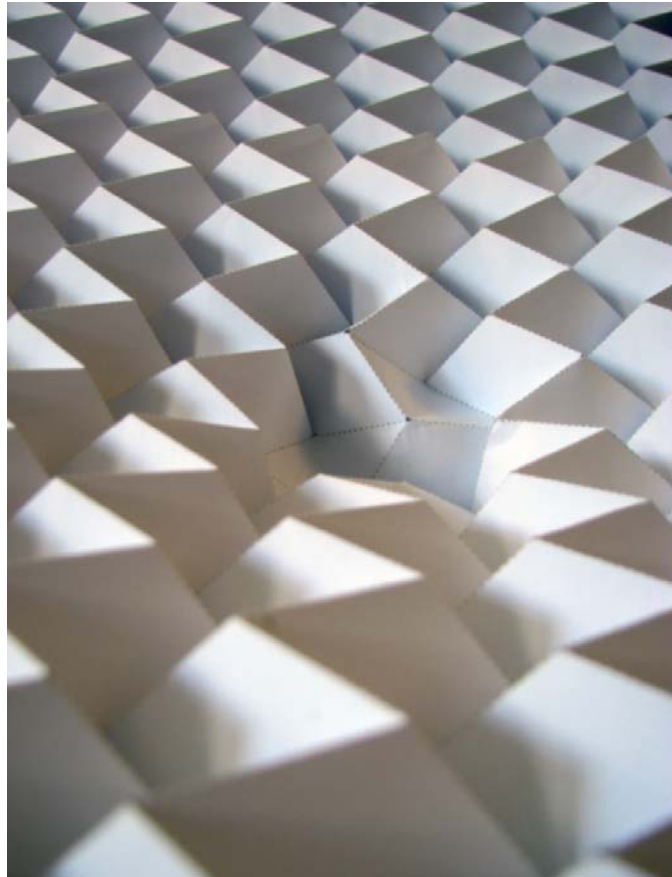


Auxetic

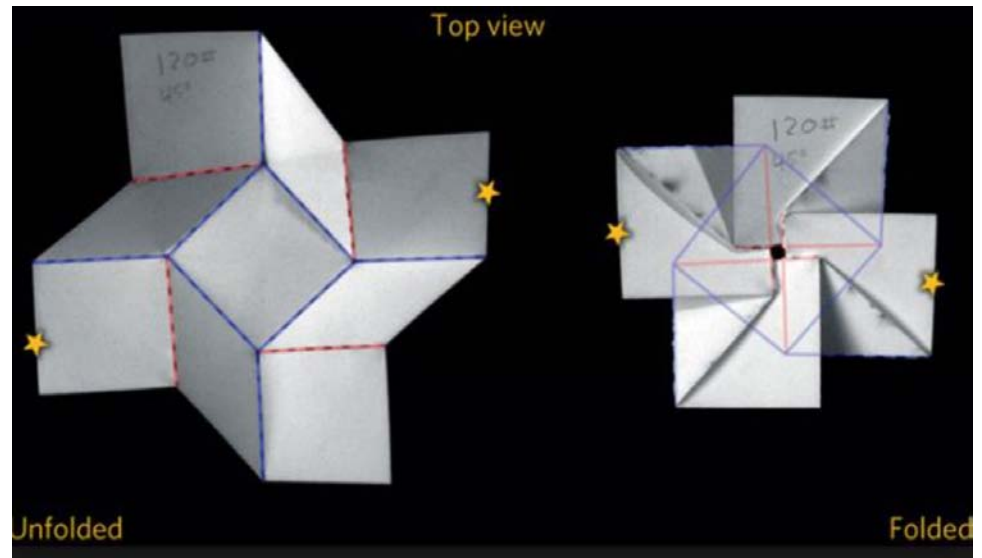
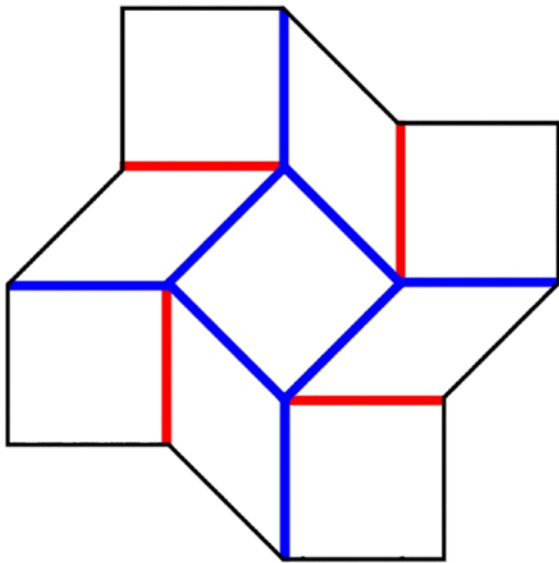


Tuneable mechanical resistance

Pop a vertex



Square Twist Demo



A switch

Strong switch

https://www.youtube.com/watch?time_continue=13&v=K_cDKb23DEA



Bistable – stable in two states

Weak switch

https://www.youtube.com/watch?time_continue=7&v=dVyydqwZNms

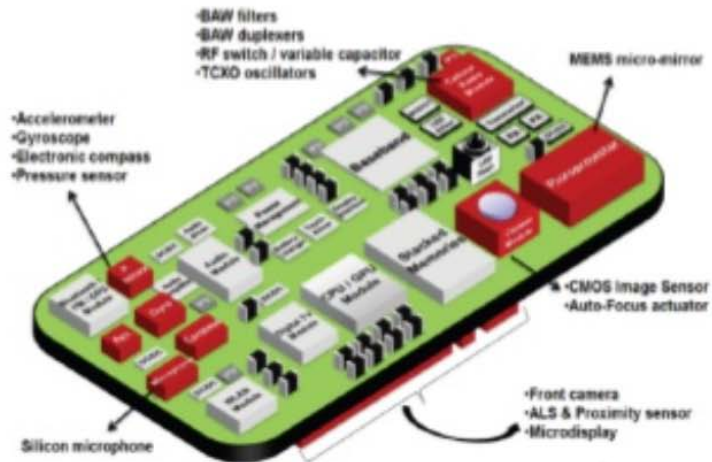
Geometry determines physical properties.

'Meta-material'

Microscale circuits.. with mechanics!

MEMS in Smart Phones

- Accelerometers
- Gyroscopes
- Electronic Compass
- Pressure Sensors
- Microphones
- Micro speakers
- Auto focus
- (Pico) Projectors
- RF MEMS



Source: Yole Development

Source: MEMS Technology Roadmapping, Michael Gaitan, NIST Chair, iNEMI and ITRS
MEMS Technology Working Groups Nano-Tec Workshop 3, 31 May 2012

Robotics and origami

Robot folds self, walks away

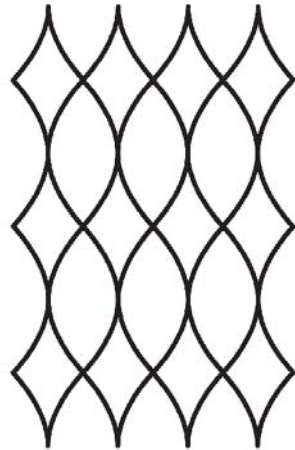


Felton 2014

<https://youtu.be/9M1zNIVGrjM?t=64>

Shaping through drying

C Guberan, *HydroFold*

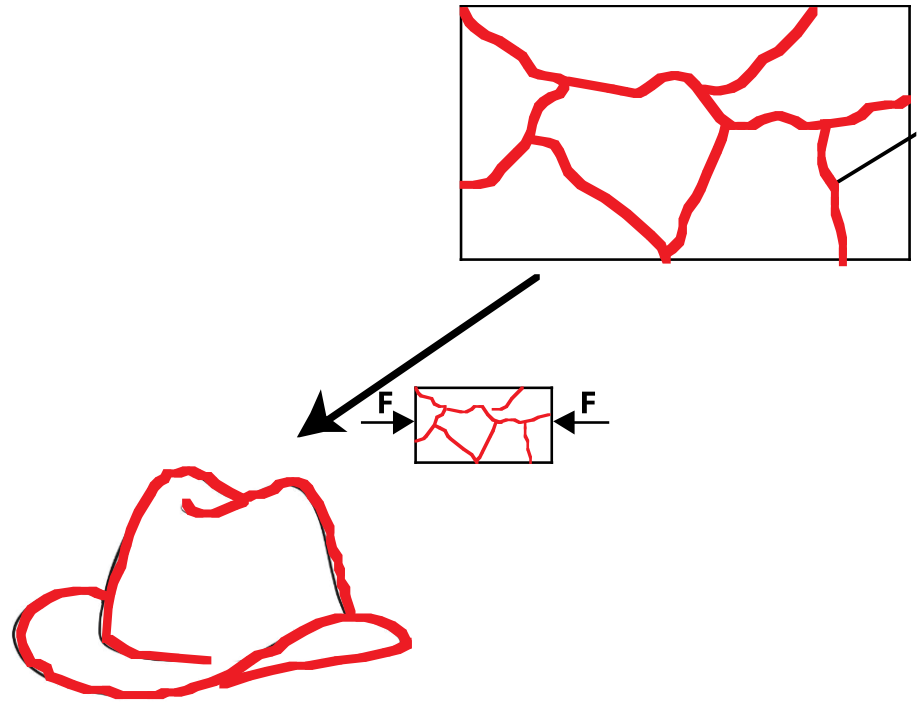


<https://vimeo.com/40307249>

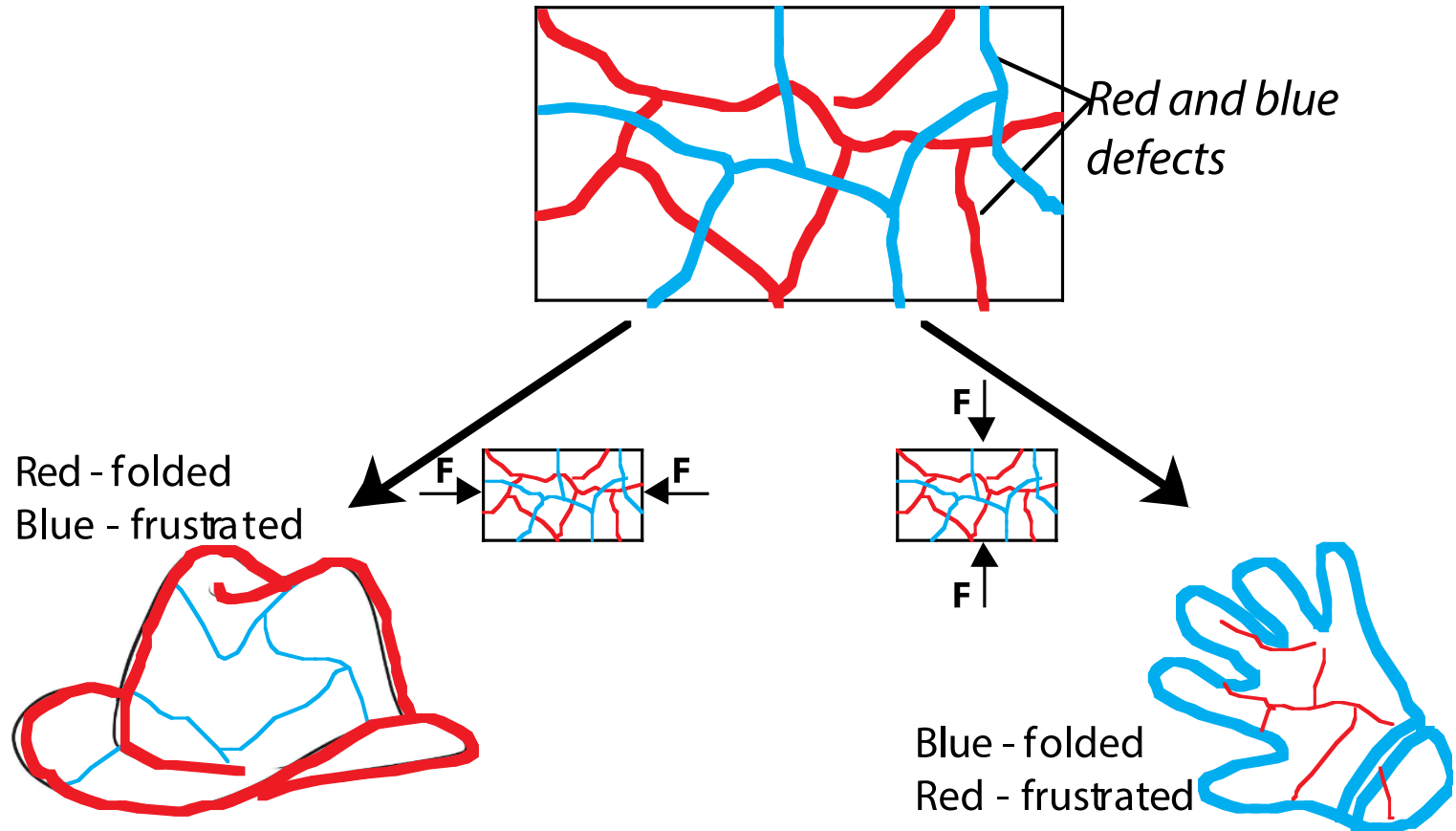
Multiple folding modes



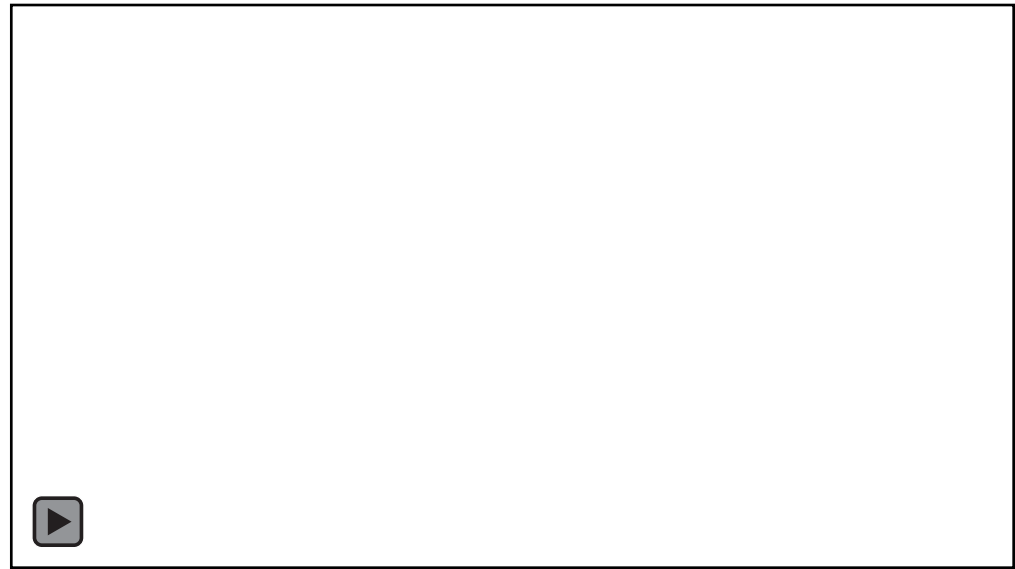
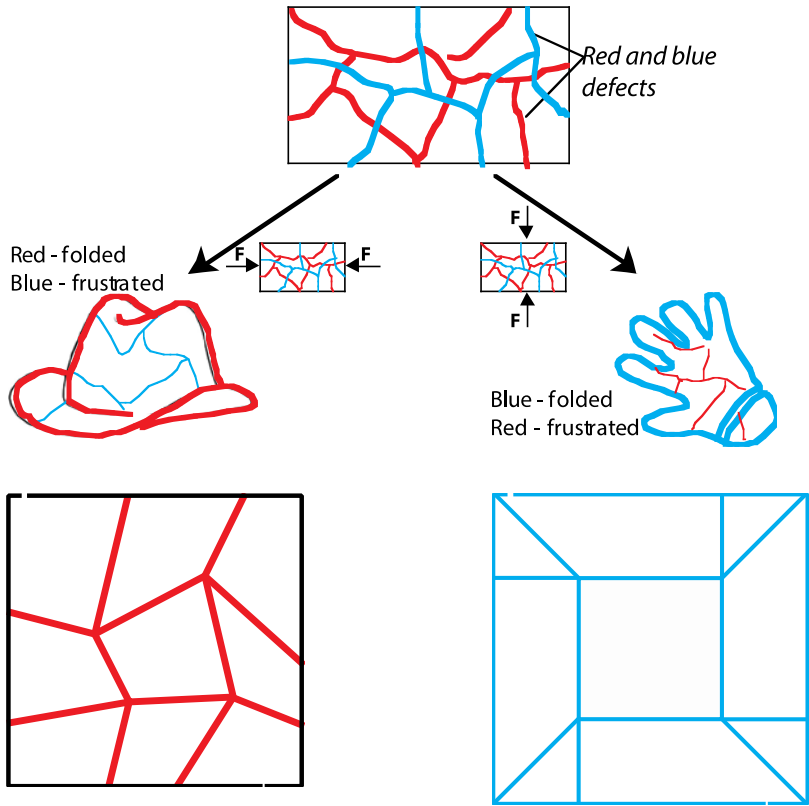
Tomohiro Tachi



Multiple folding modes



Multiple folding modes



No need to micromanage