

Hot Science Cool Talks

UT Environmental Science Institute

98

The Future of 3D Printing: The Democratization of Design

Dr. Carolyn Seepersad

October 16, 2015

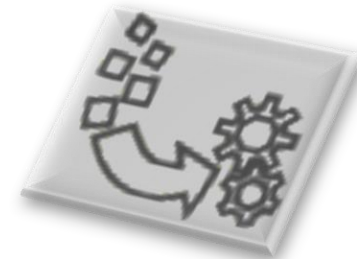
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The Future of 3D Printing: The Democratization of Design

Carolyn Conner Seepersad, PhD
Associate Professor and General Dynamics Faculty Fellow

October 16, 2015

Product, Process, and Materials Design Laboratory
and Laboratory for Freeform Fabrication
Mechanical Engineering Department
The University of Texas at Austin



3D Print Almost Anything... Almost Anywhere...



Engine parts,
GE



3D Print Almost Anything... Almost Anywhere...



**Cake,
3DSystems/Culinary**

3D Print Almost Anything... Almost Anywhere...



**Sculpture,
Bathsheba
Grossman**

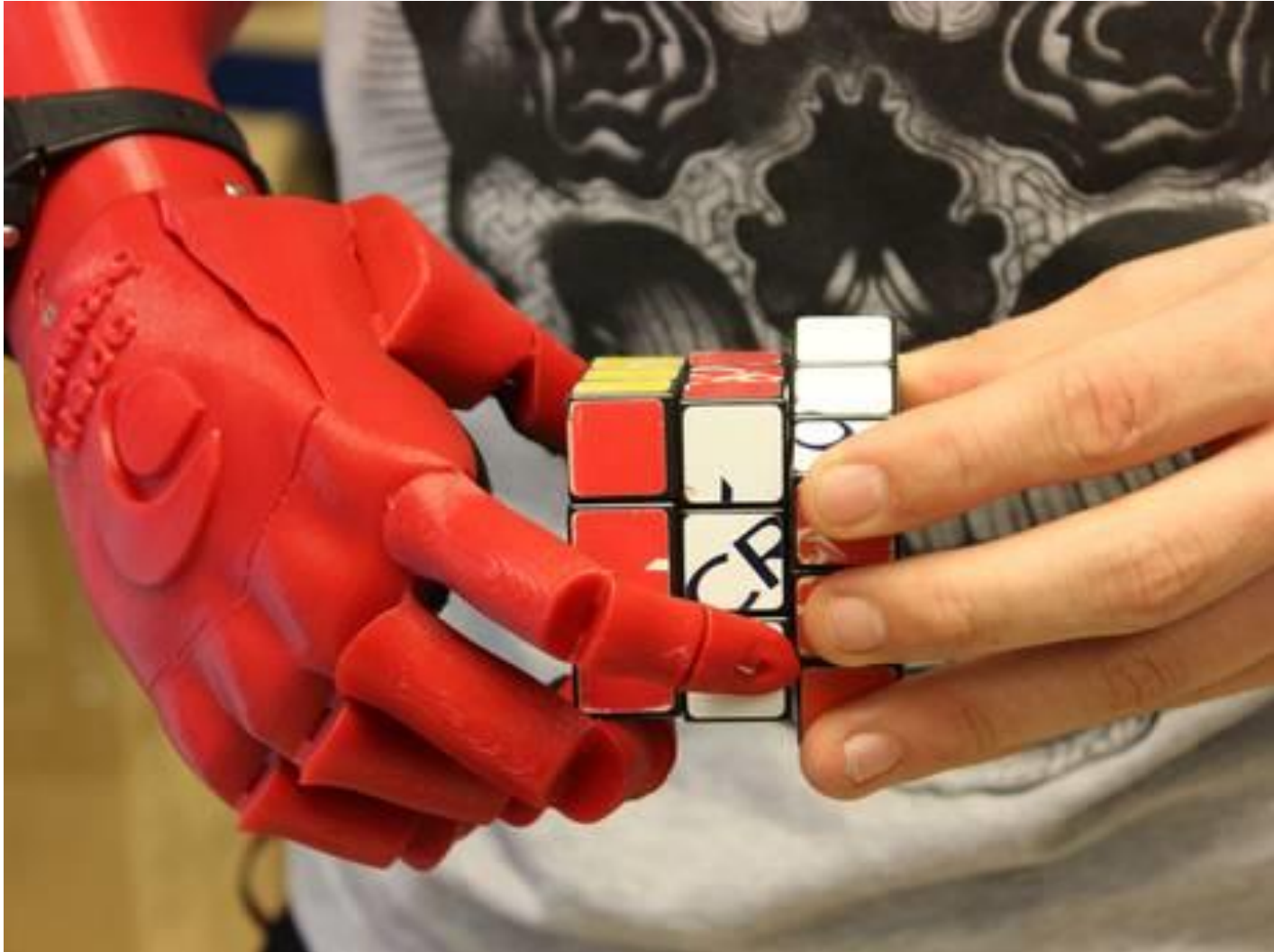


3D Print Almost Anything... Almost Anywhere...



**Prosthetics,
Bespoke Innovations**

3D Print Almost Anything... Almost Anywhere...



Prosthetics, Open Bionics

3D Print Almost Anything... Almost Anywhere...



Longhorn Maker Studio at UT Austin

3D Print Almost Anything... Almost Anywhere...



Medical devices, Not Impossible Labs (Sudan)

3D Printing: The Next Industrial Revolution?



Cranial implants, Custom IMD

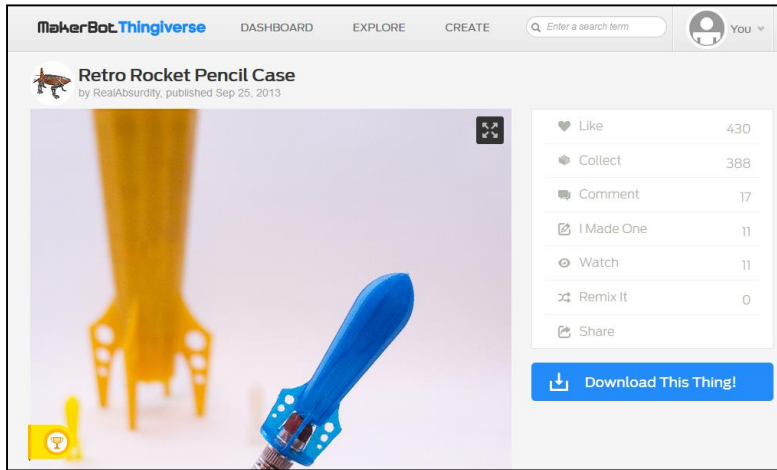


***Why are we so fascinated by
3D printing?***

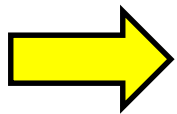


How does 3D printing work?

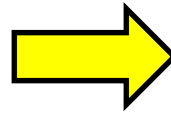
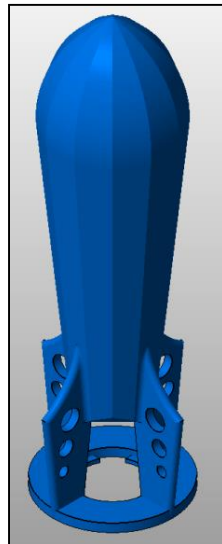
How does 3D printing work?



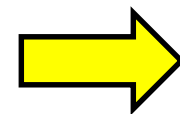
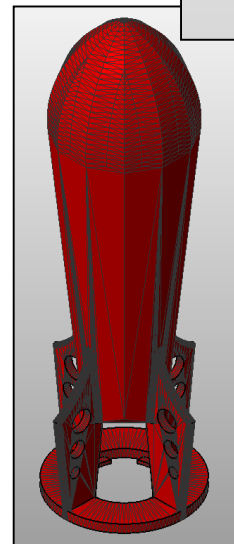
thingiverse.com



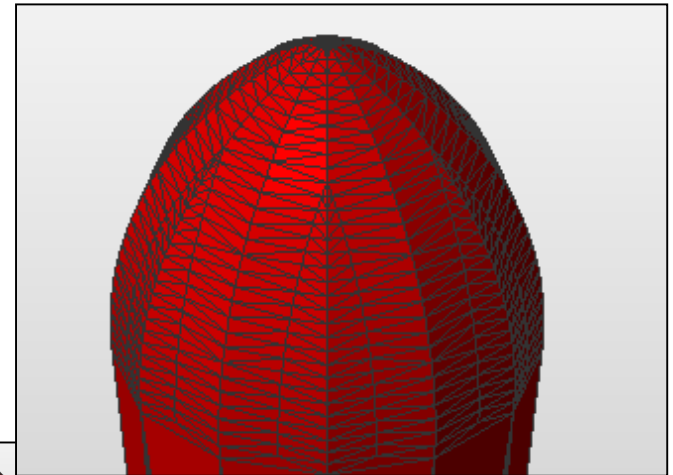
CAD



STL

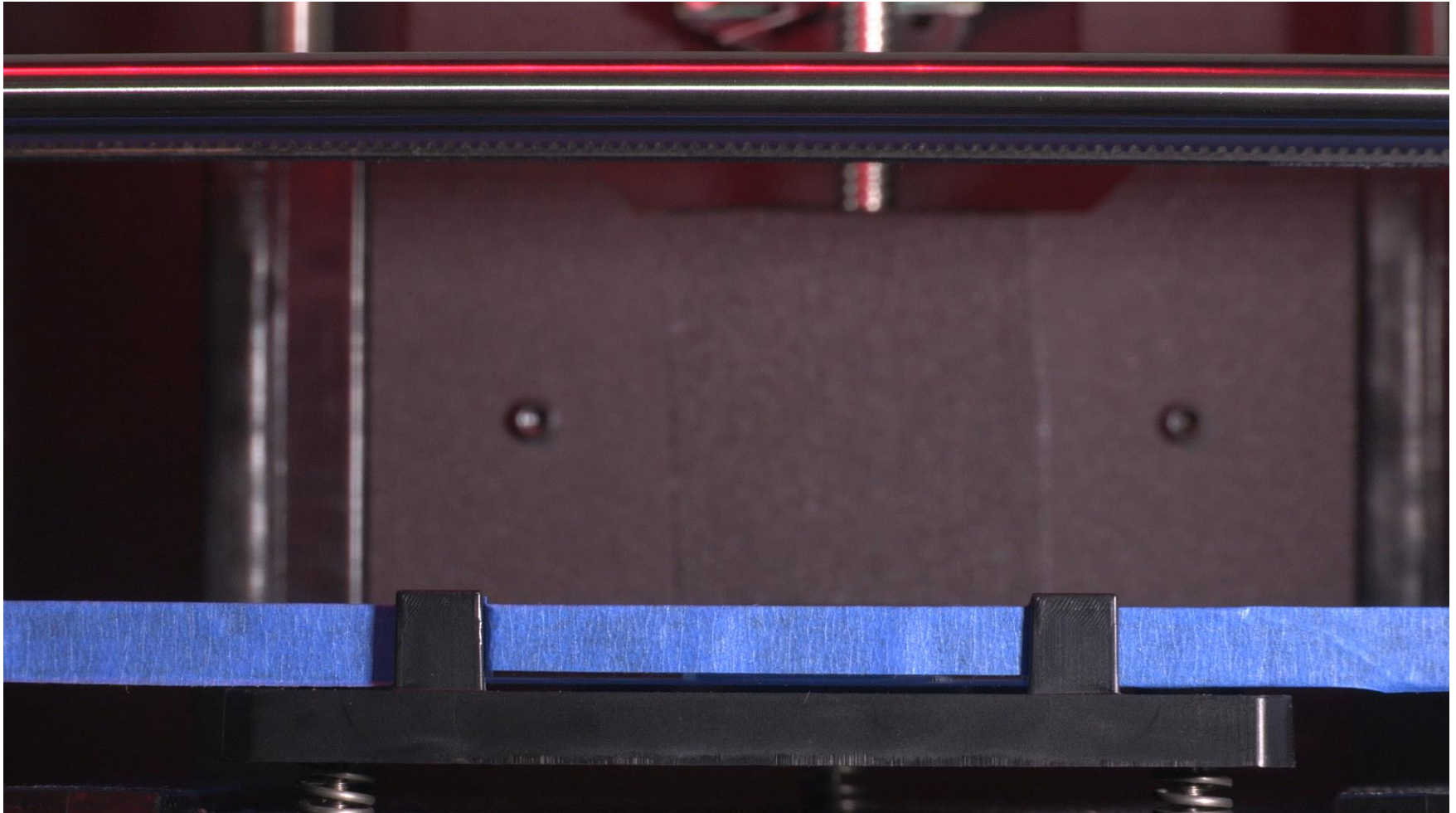


3D Printer



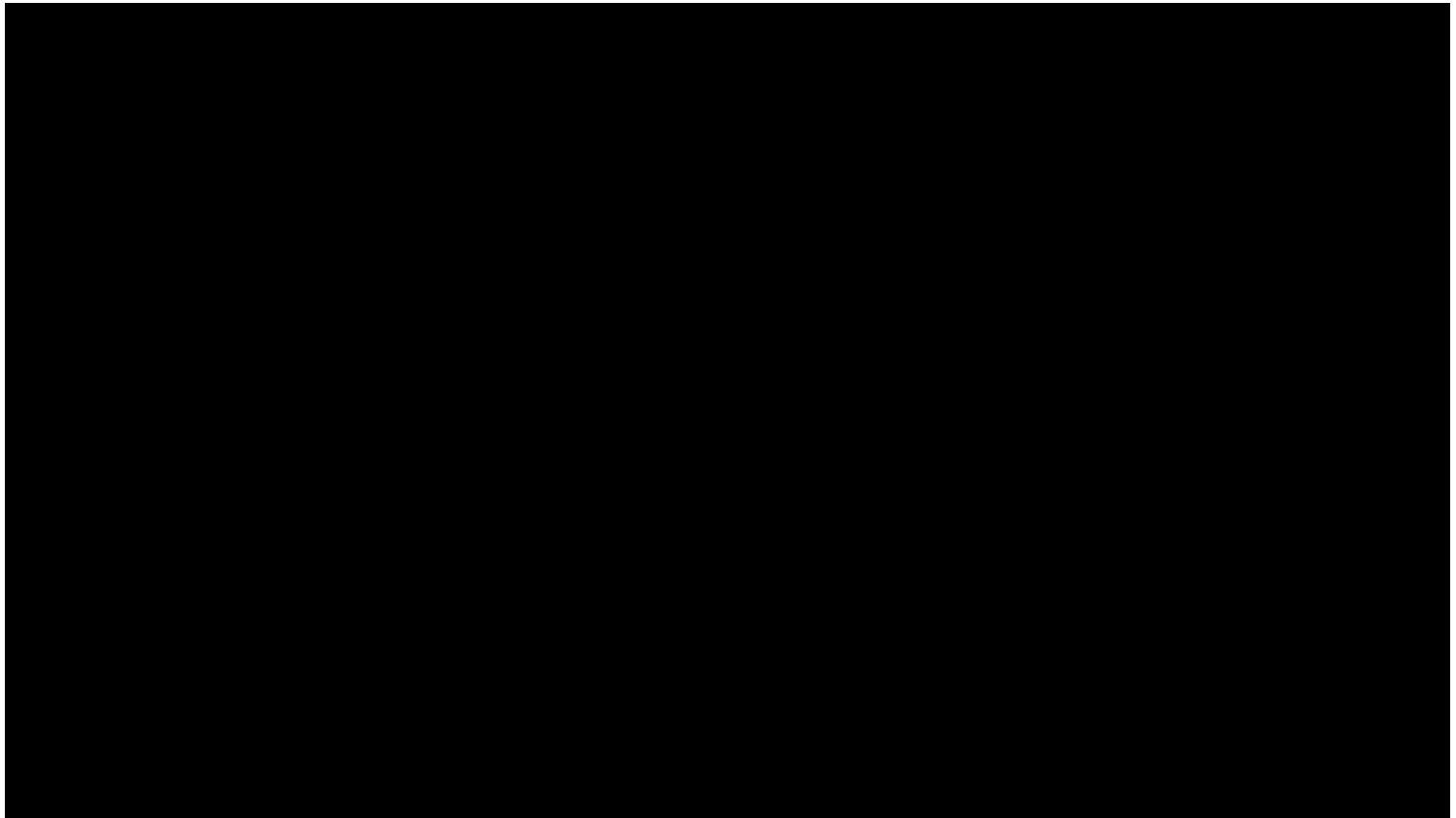
How does 3D printing work?

Material Extrusion Process



How does it work?

Laser Sintering Process





***Why is it (technically) called
Additive Manufacturing?***

Why is it (technically) called *Additive Manufacturing?*

Other kinds of manufacturing:

Molding

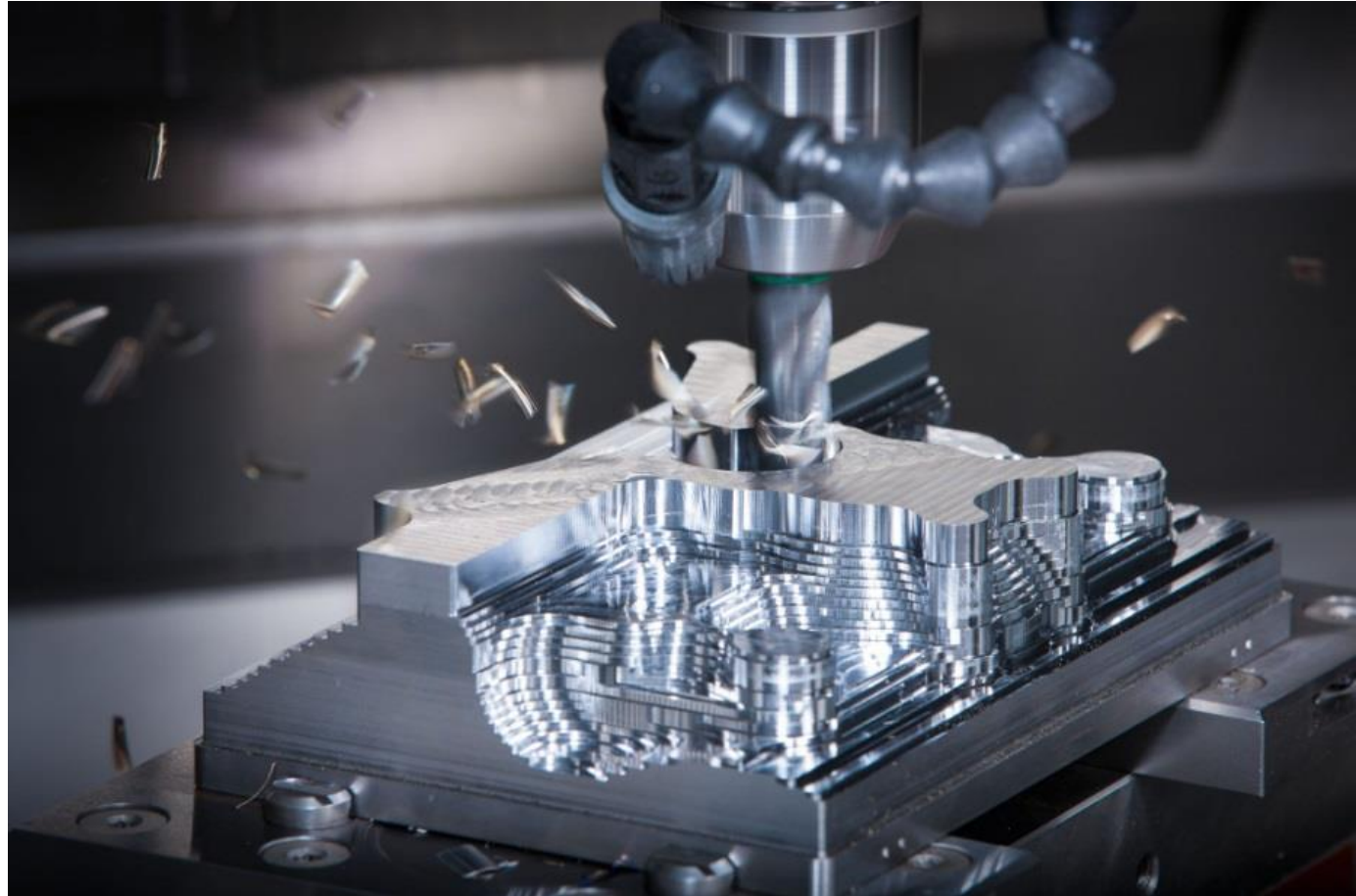


Why is it (technically) called

Additive Manufacturing?

Other kinds of manufacturing:

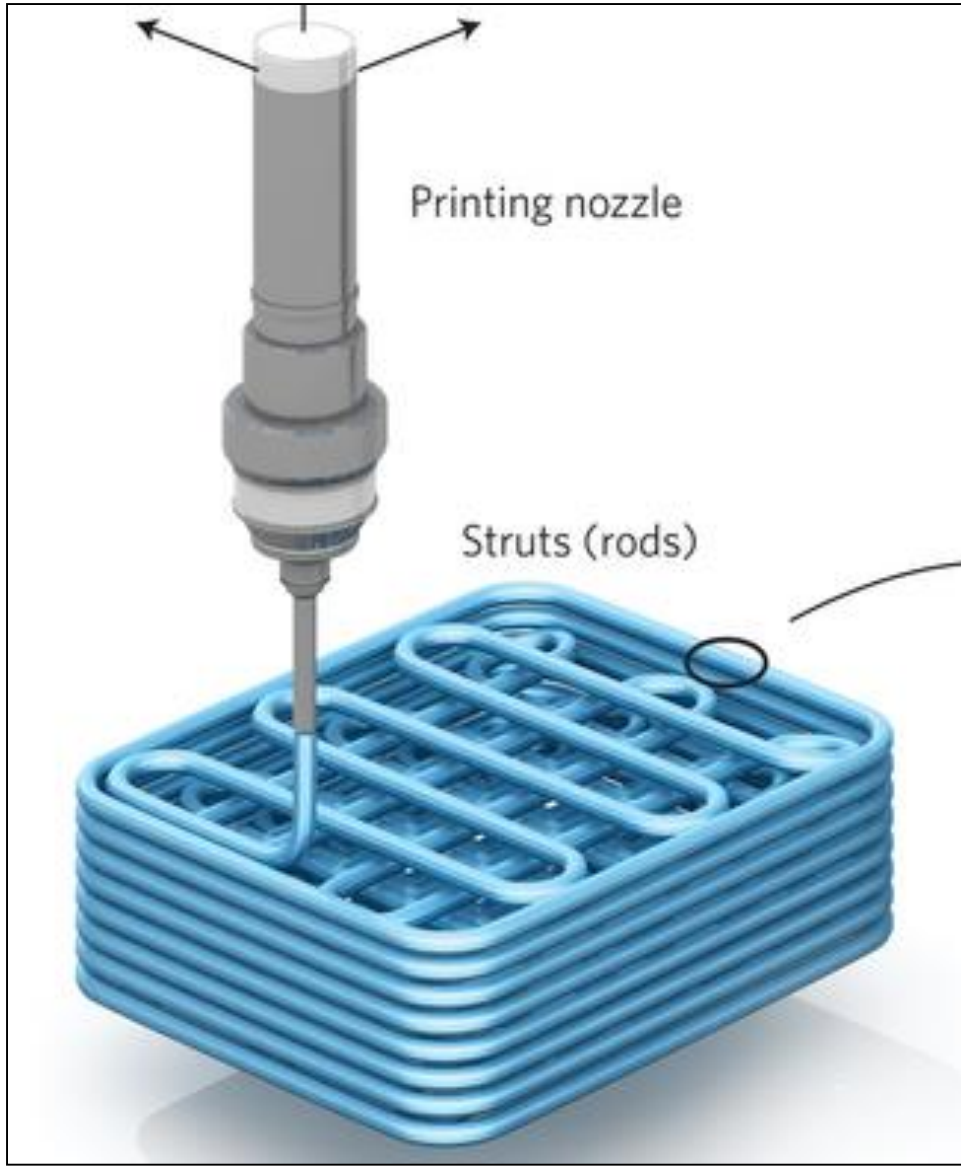
Subtractive



Why is it (technically) called *Additive Manufacturing*?



Additive



Wegst, et al., *Nature*



***What are the origins of
additive manufacturing?***

The Origins of Additive Manufacturing Nature

Timeline ↑



***Beginning of time:
Nature***



The Origins of Additive Manufacturing

3D Photosculptures (1860s)



Timeline ↑

**1860s-1870s:
Photosculptures**

*Beginning of time:
Nature*



Admiral Farragut sits for photosculpture, late 1860's

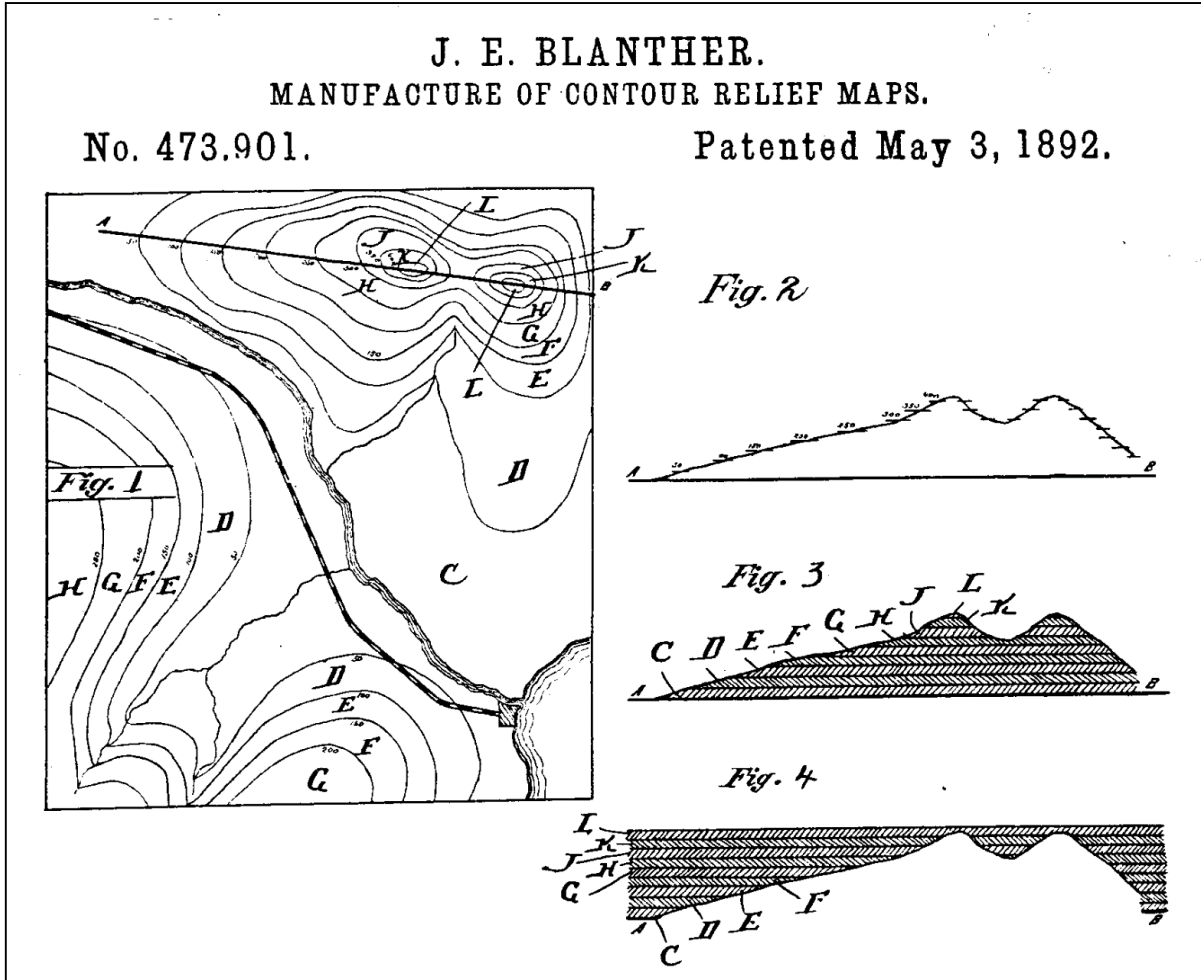
The Origins of Additive Manufacturing Topography Techniques (1892)

Timeline ↑

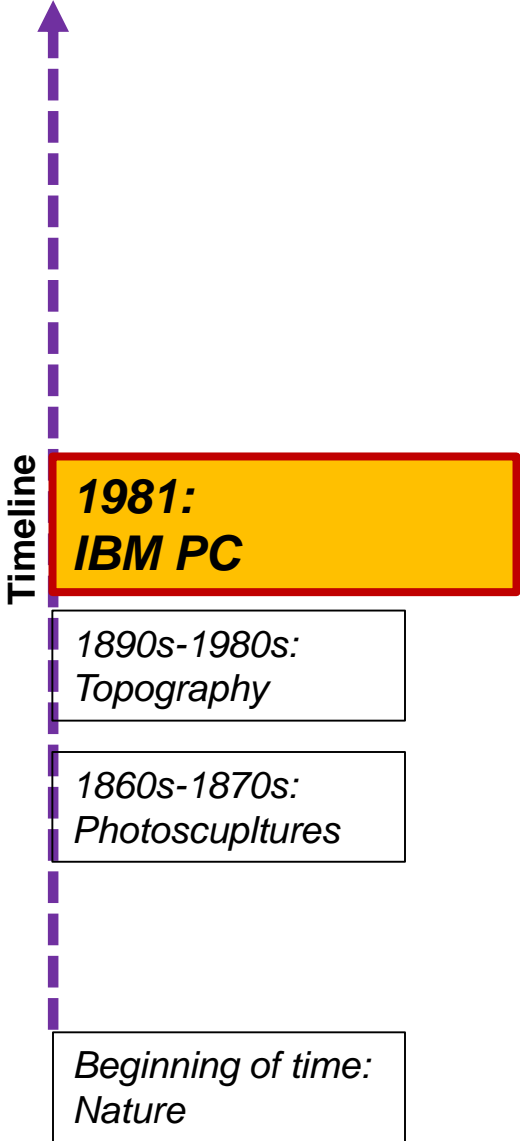
**1890s:
Topography**

1860s-1870s:
Photoscultures

Beginning of time:
Nature



The Origins of 3D Printing



IBM 5150 PC

The Origins of 3D Printing

Laser Sintering, Stereolithography, FDM



Timeline

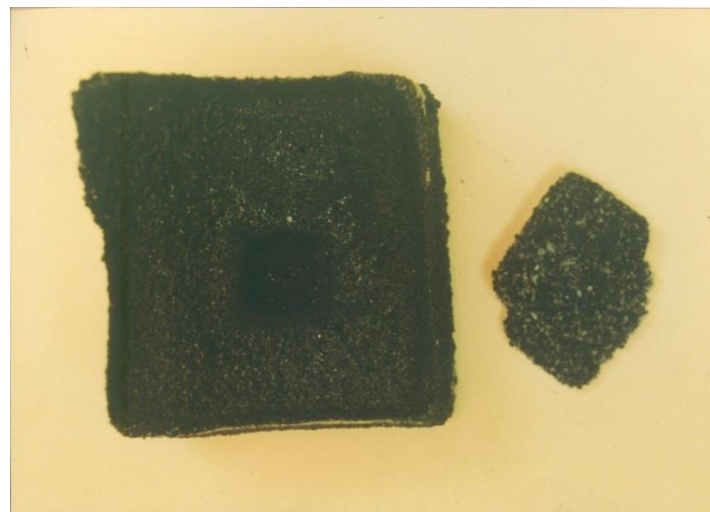
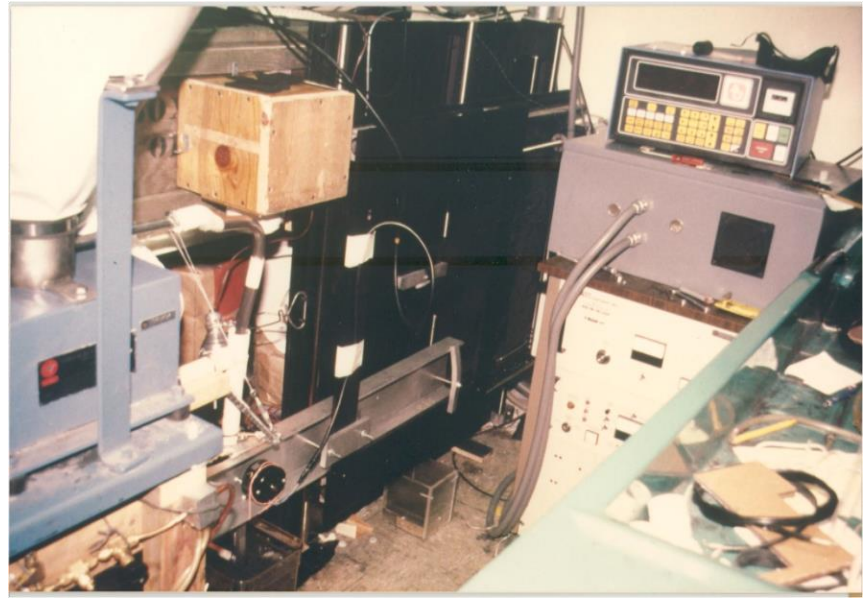
1984-1989:
Laser Sintering
Stereolithography
FDM

1981:
IBM PC

1890s-1980s:
Topography

1860s-1870s:
Photoscultures

Beginning of time:
Nature



Early Laser Sintering at UT Austin

Carl Deckard
Joe Beaman

Present Day: New Industrial Revolution?

1989:
Fused Deposition Modeling

1986:
Laser Sintering

1984:
Stereolithography

1890s-1980s:
Topography

1860s-1870s:
Photocaptures

Beginning of time:
Nature

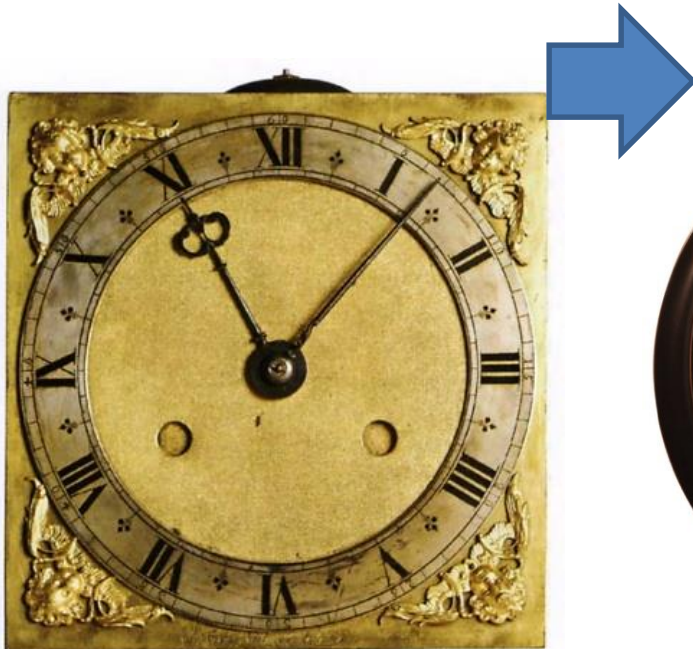


Timeline



***Is 3D printing the next
industrial revolution?***

Is 3D Printing the next industrial revolution?



Oxford Museum of the History of Science
ahsoc.org

Ely, Kashdan, Kuhr, Swantner, Vaughan
UT Austin



***So, what are we 3D
printing now?***

One-of-a-kind fabrication



Personal Customization



Invisalign

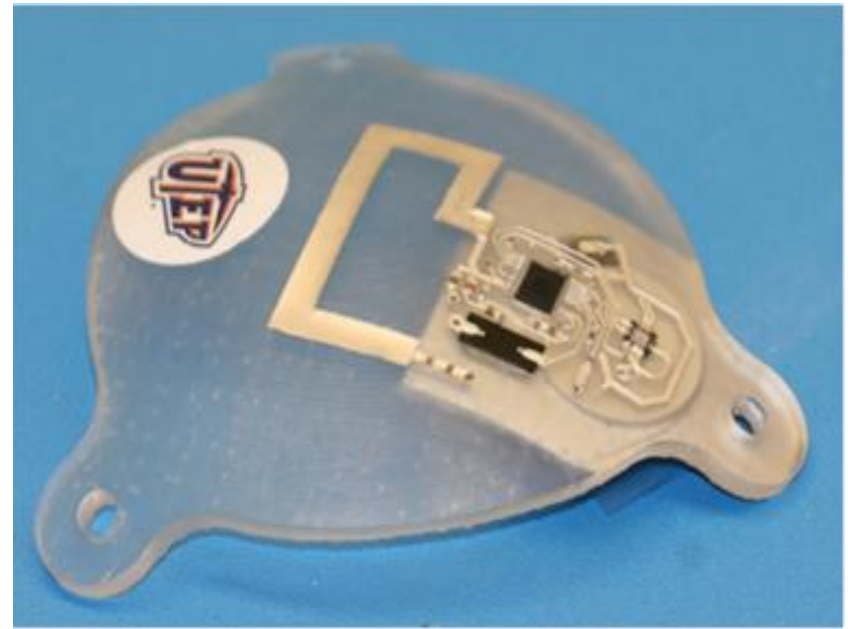


Crawford, Neptune, et al.
UT Austin


Functional complexity



GE/EADS via Ponoko.com



Lopes, MacDonald, Wicker, 2012, *RPJ*



A Snapshot of One of My Research Projects

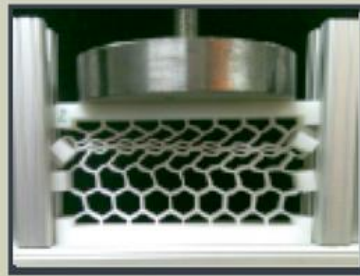
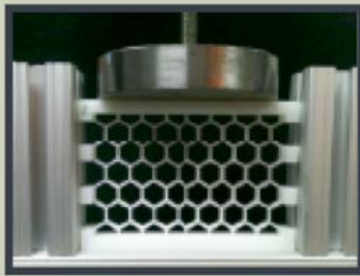
Collaborators:

Mike Haberman, Preston Wilson, Desi Kovar,
Dixon Correa, Tim Klatt, Sergio Cortes,
Ken Bostwick, Mark Kershisnik, Jared Allison,
Zahra Ahmed

Negative Stiffness Honeycombs with Superior Impact Protection

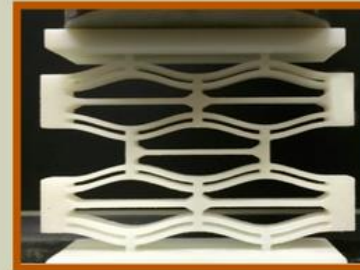
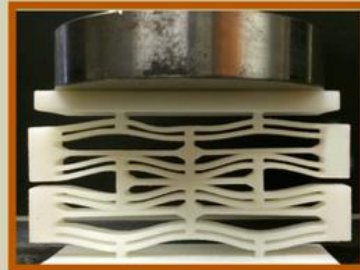
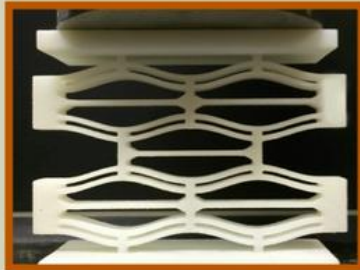
Conventional Honeycomb

Plastic buckling has a short, one-compression lifespan



New NS Honeycomb

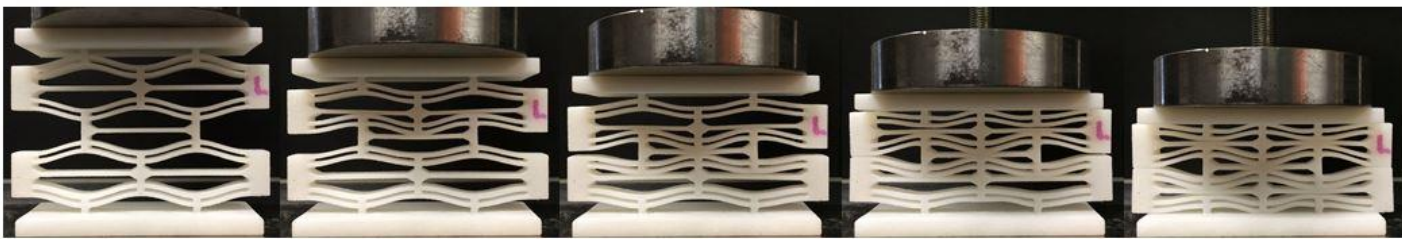
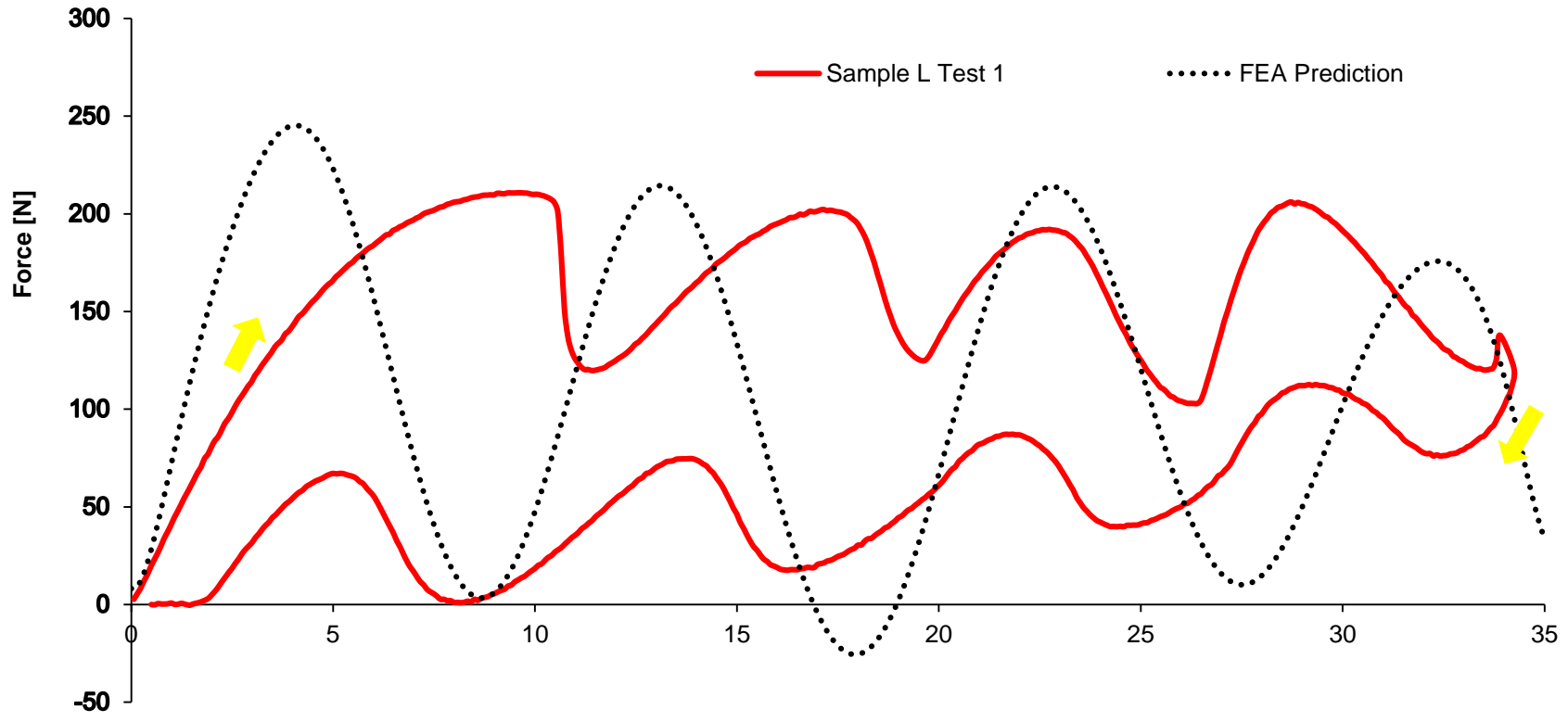
Elastic buckling is resilient, allowing for multiple compressions



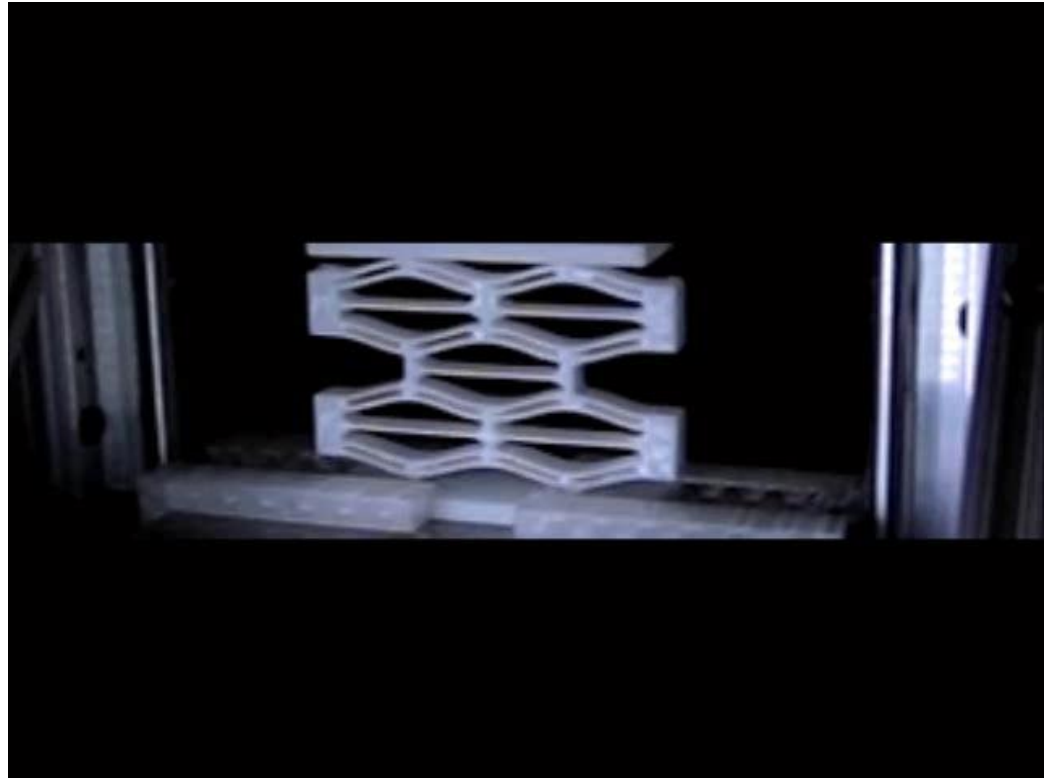
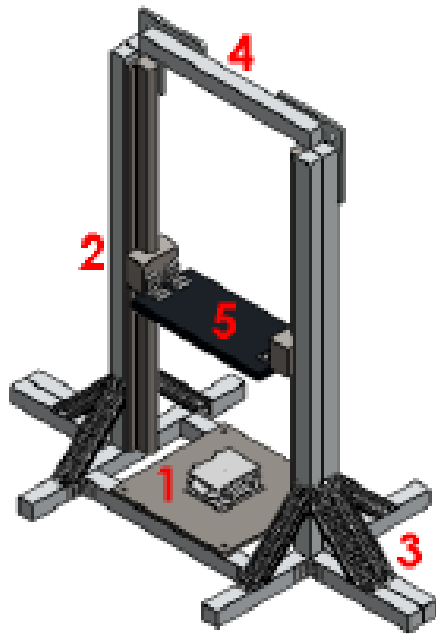
Negative Stiffness Honeycombs with Superior Impact Protection

Demonstration of a
Negative Stiffness (NS) Honeycomb
showing elastic buckling

Compressive Behavior of NS Honeycomb

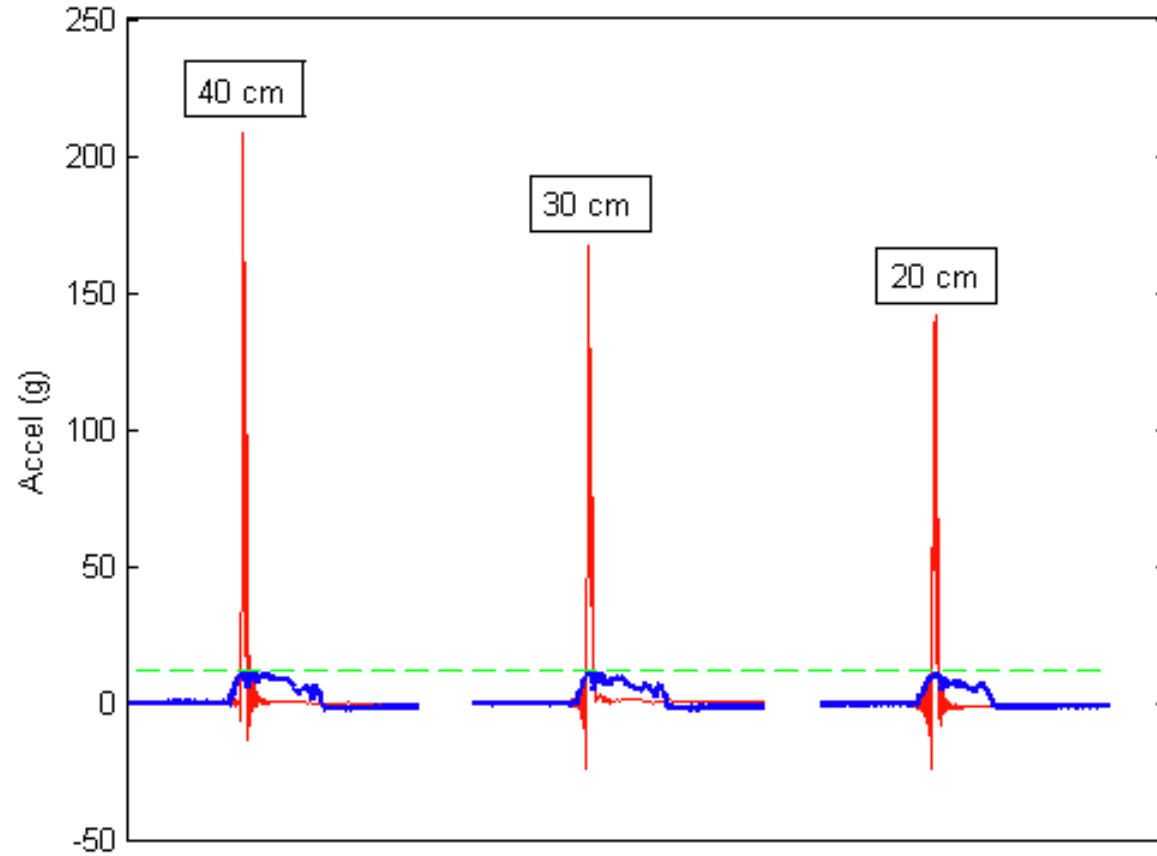


Impact Performance of NS Honeycombs

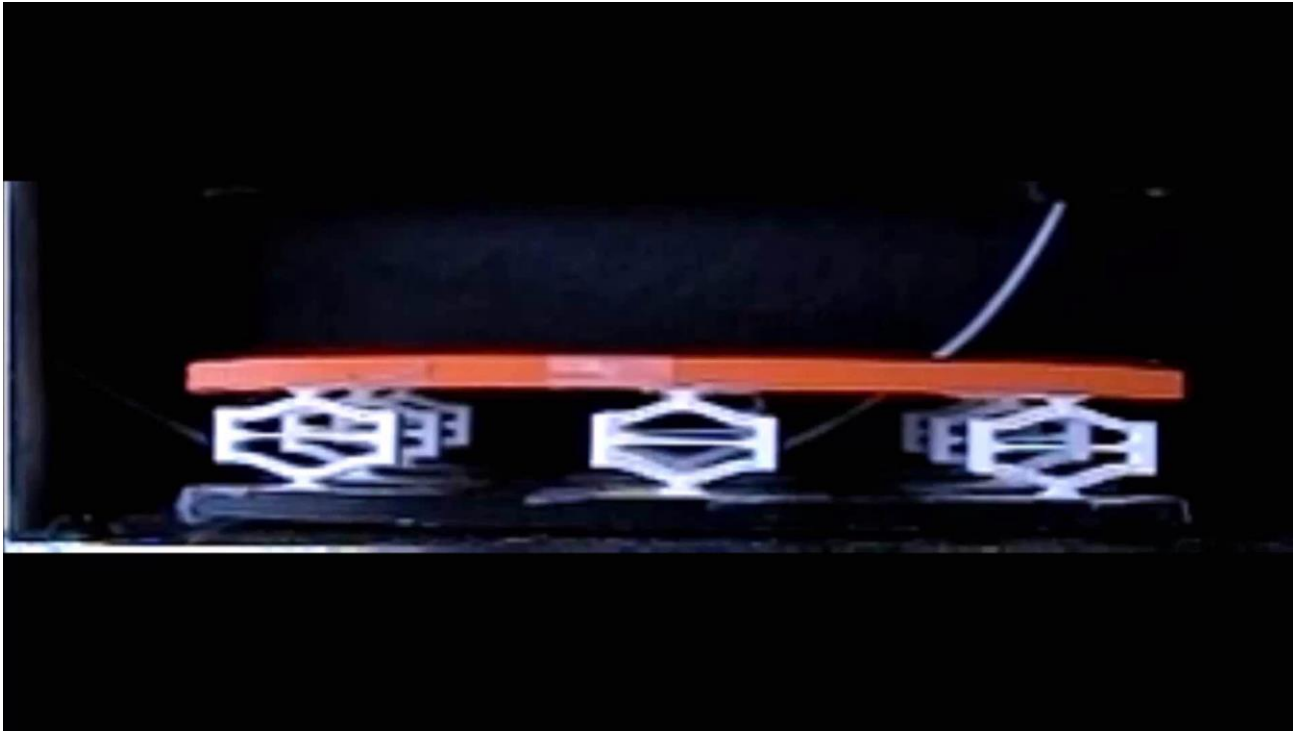


High speed video of a negative stiffness honeycomb under impact [5].

Impact Behavior of NS Honeycomb

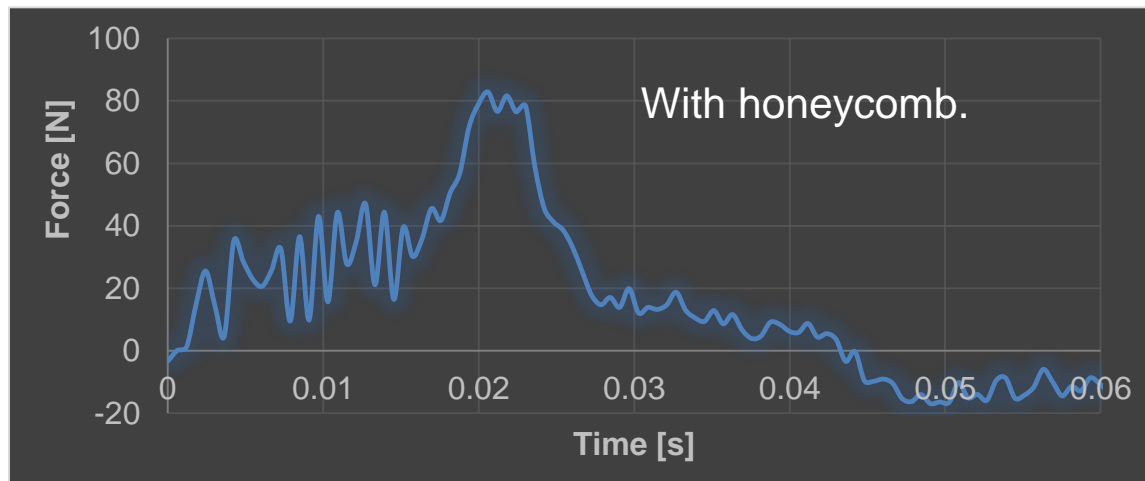
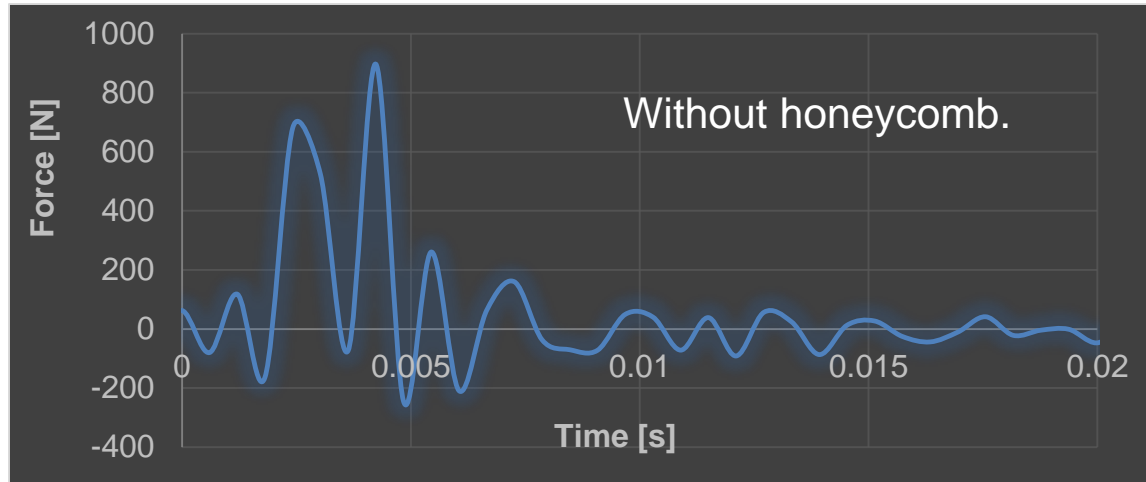


Personal Protection Applications



Prototype impact captured by high speed camera.

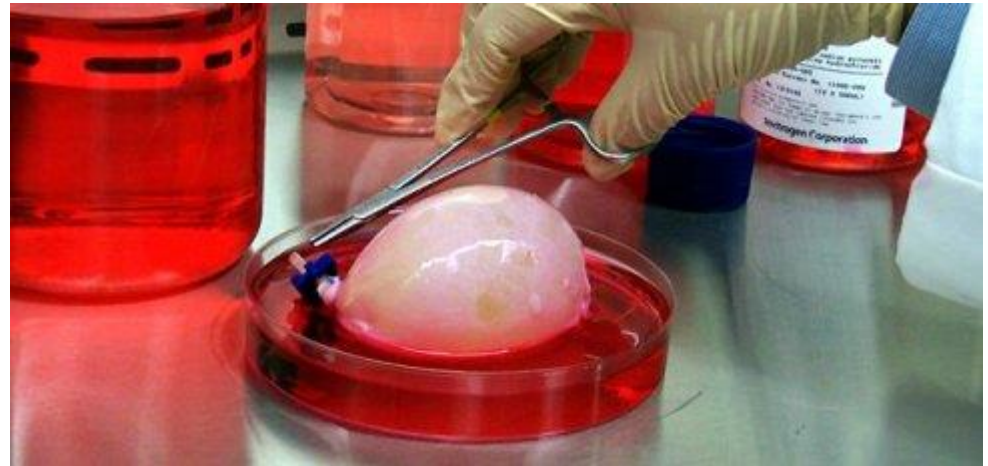
How does it feel to wear this device?





***Where do we go
from here?***

New Frontiers ...



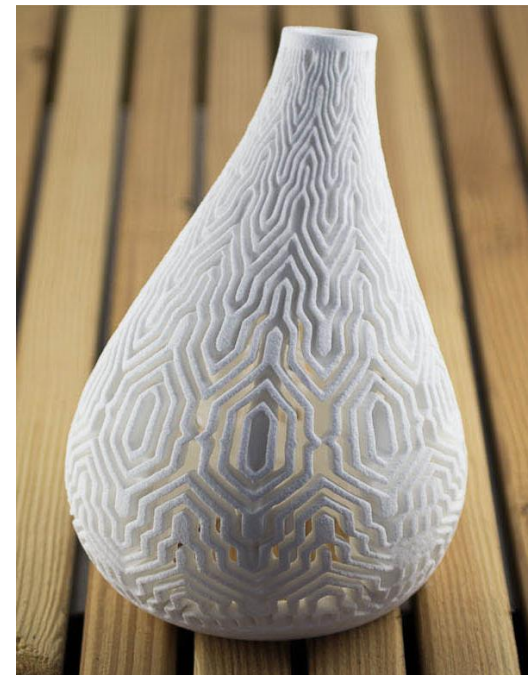
Mansoor et al., 2013, Princeton
(Extremetech.com)

Attala, Wake Forest University

New Frontiers ...



Cornucopia: Digital Gastronomy



The Sugar Lab



Cornell Creative Machines Lab

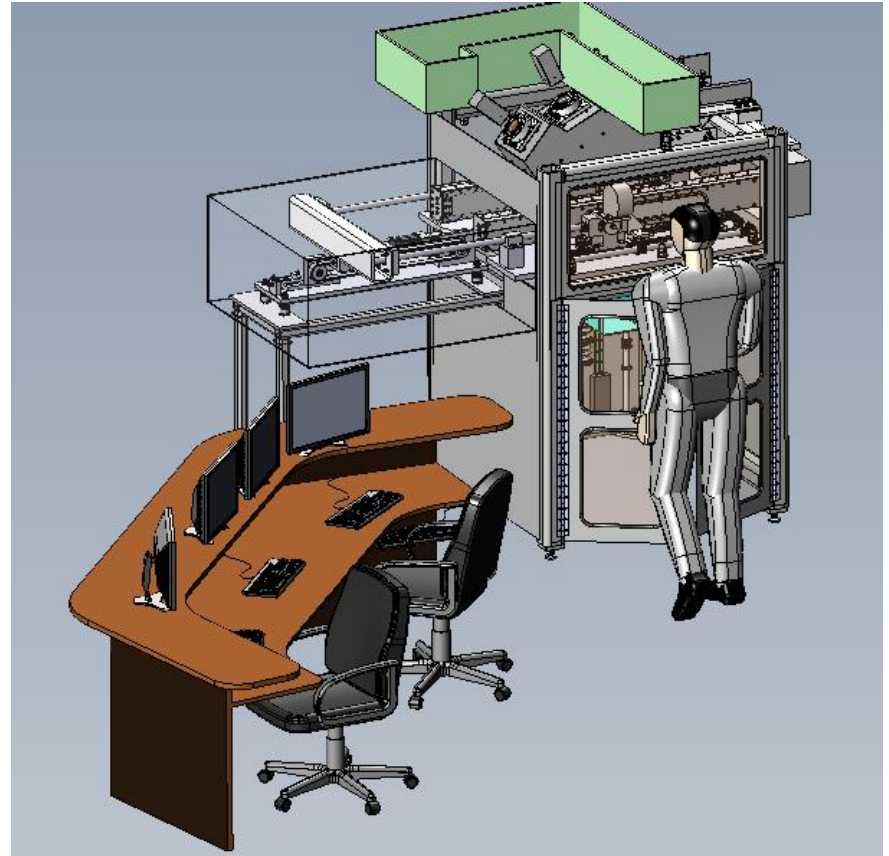
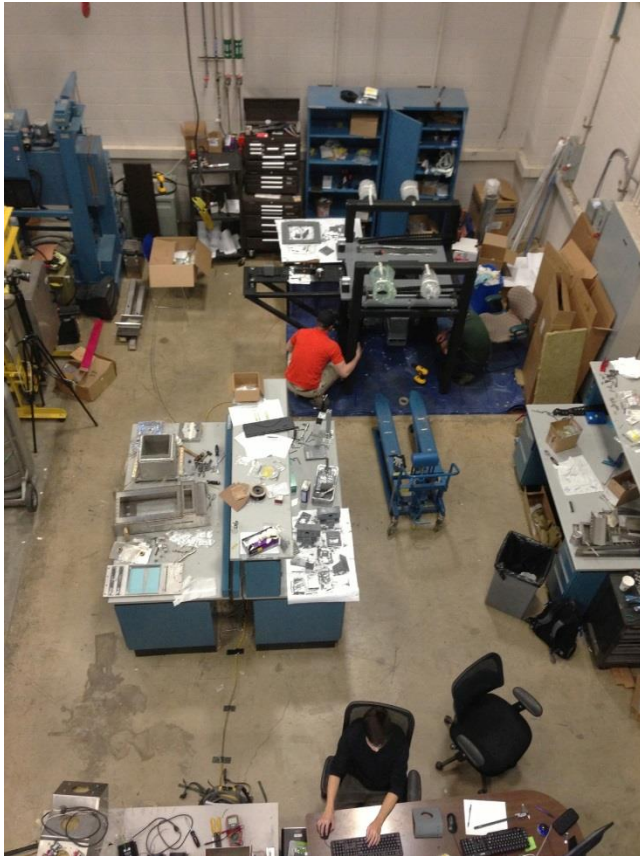


New Frontiers ...



Barron, Gallagher, Cook, Pradhan, Wang, UT Austin
Autodesk 123D

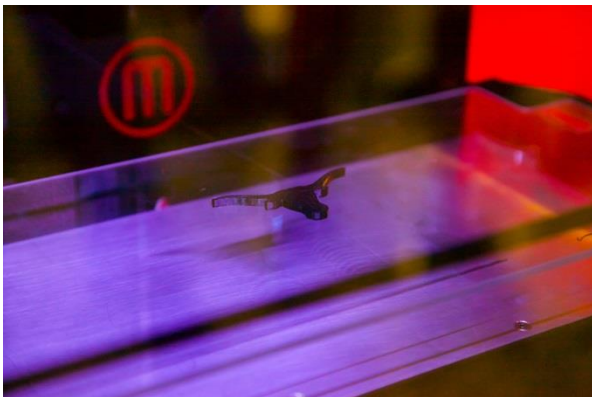
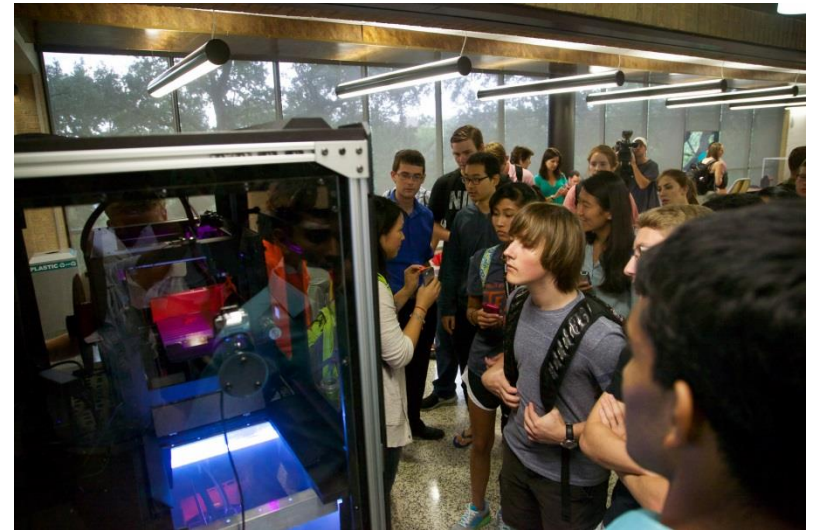
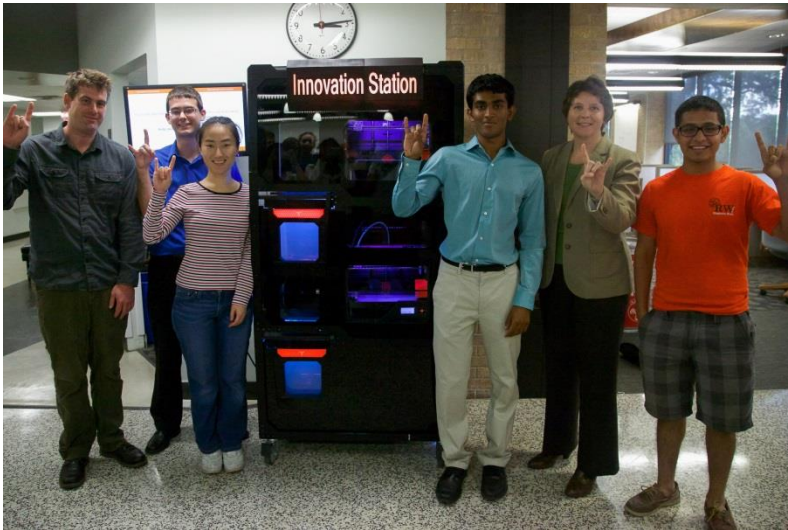
New Frontiers ...



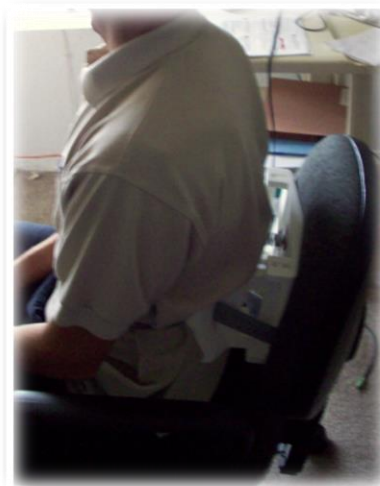
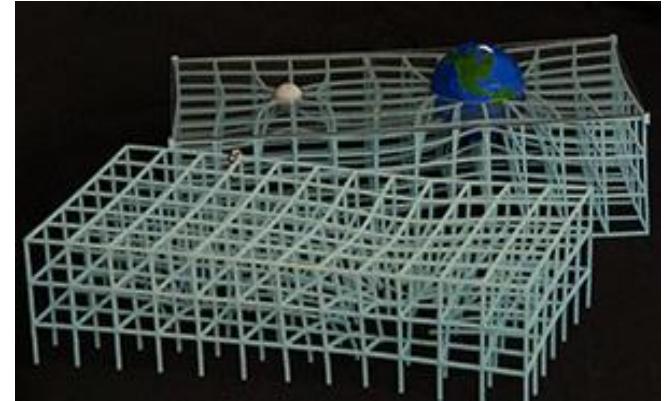
LAMPS, Courtesy of Beaman, Fish, and colleagues

New Frontiers ...

Innovationstation.utexas.edu



What will you make?



Student Projects, UT Austin



What will you make?

Team Acknowledgements





Dr. Carolyn Seepersad



Dr. Carolyn Seepersad's research focuses on developing methods and computational tools for engineering design. She led the creation of The Innovation Station, the first of its kind 3D printing vending machine, accessible to all students on the campus of UT Austin.

Dr. Seepersad is an Associate Professor in the Department of Mechanical Engineering at The University of Texas at Austin. Dr. Seepersad has earned many awards for her research and teaching, including the 2009 inaugural International Outstanding Young Researcher Award in Freeform and Additive Manufacturing from the additive manufacturing community, the 2010 University of Texas Regents' Award for Outstanding Teaching by an Assistant Professor. She has also authored more than 100 peer-review conference and journal publications and one book.