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#### Mechanics and Dynamics of Soft Additively Manufactured Elastomers with Extreme Stretchability

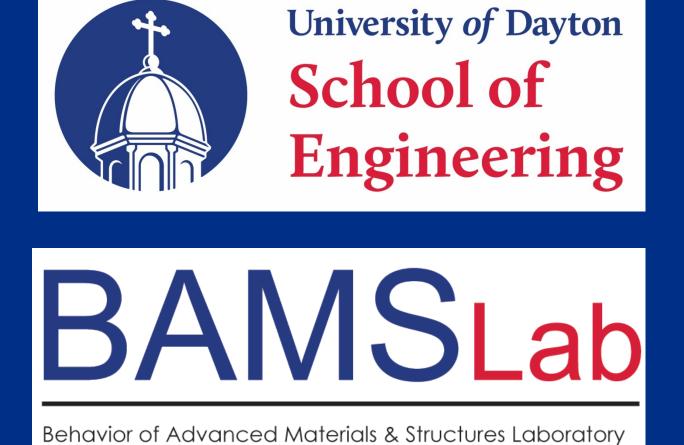
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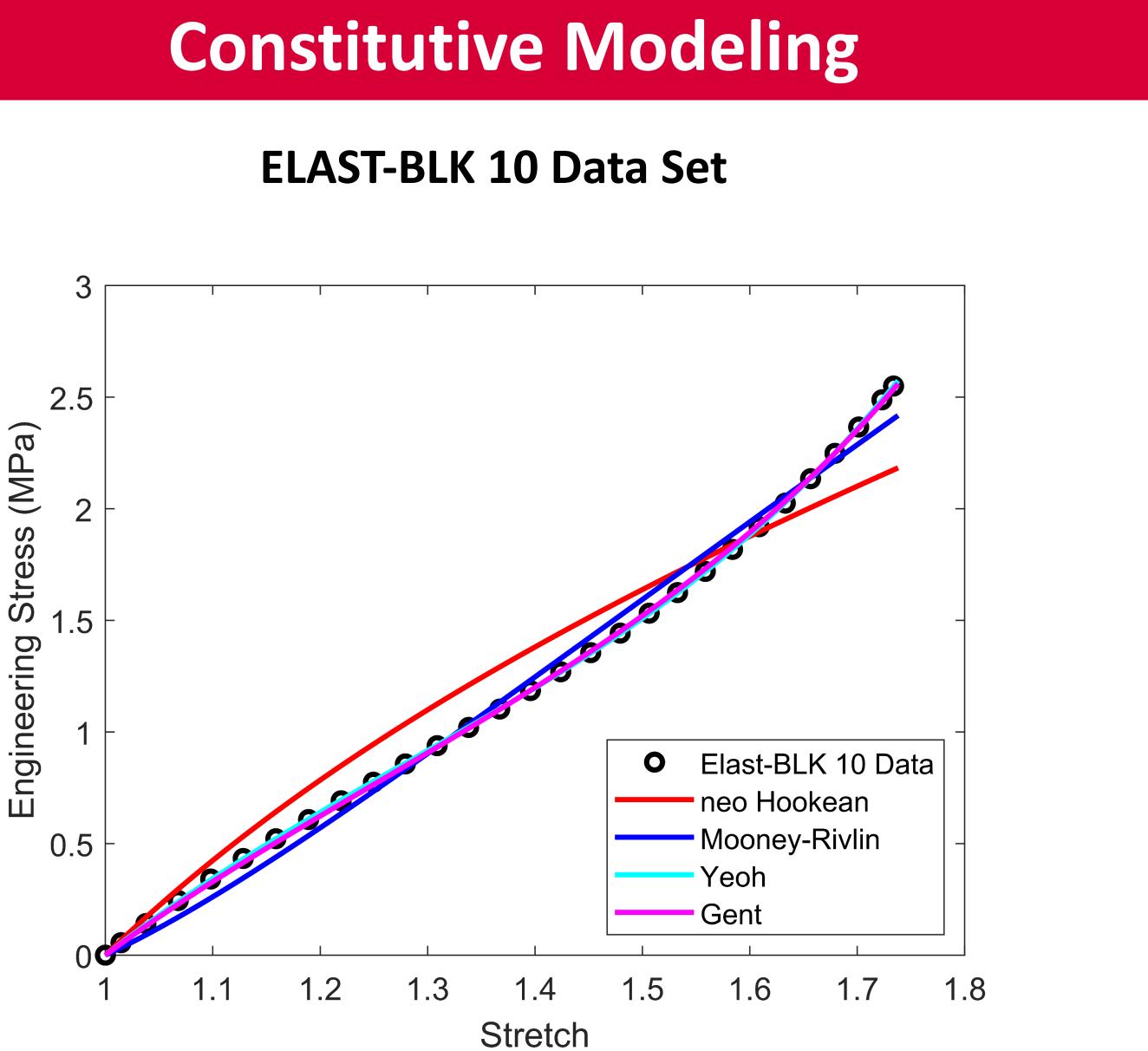
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# Mechanics and Dynamics of Soft Additively Manufactured Elastomers with Extreme Stretchability

#### **Introduction and Goals**

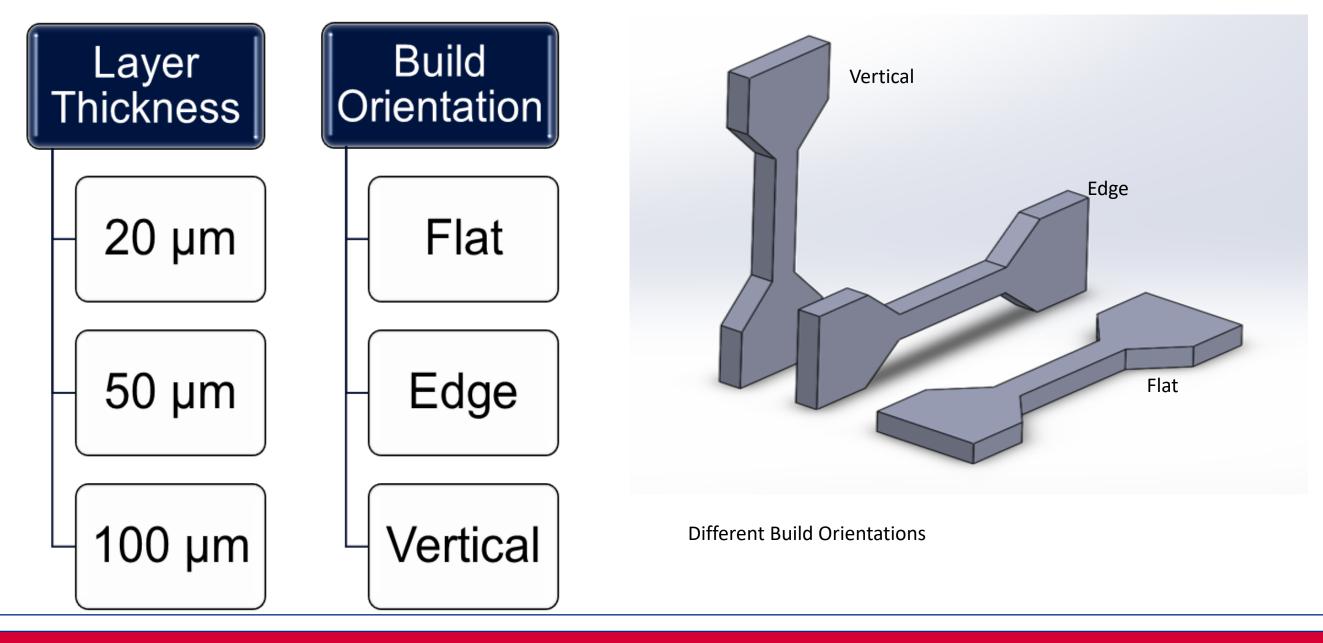
- Manufacturing (AM) Additive process of building a 3D part layer by layer from metal/polymer feedstock.
- Digital Light Processing (DLP) is the AM method used in this project.
- Soft stretchable elastomers, thin sphere Mechanical properties are dependent on DLP process parameters.
- Goal: Investigate how different process parameters impact the tensile properties of soft 3D-printed elastomers and how a spherical membrane of such material dynamically responds to pressure
- **Applications:** Prosthetics, soft robotics, on-demand components for legacy aircraft



<sup>1</sup>Department of Mechanical and Aerospace Engineering, University of Dayton; <sup>2</sup>Department of Mechanical Engineering, Oakland University

# **Materials and 3D Printing**

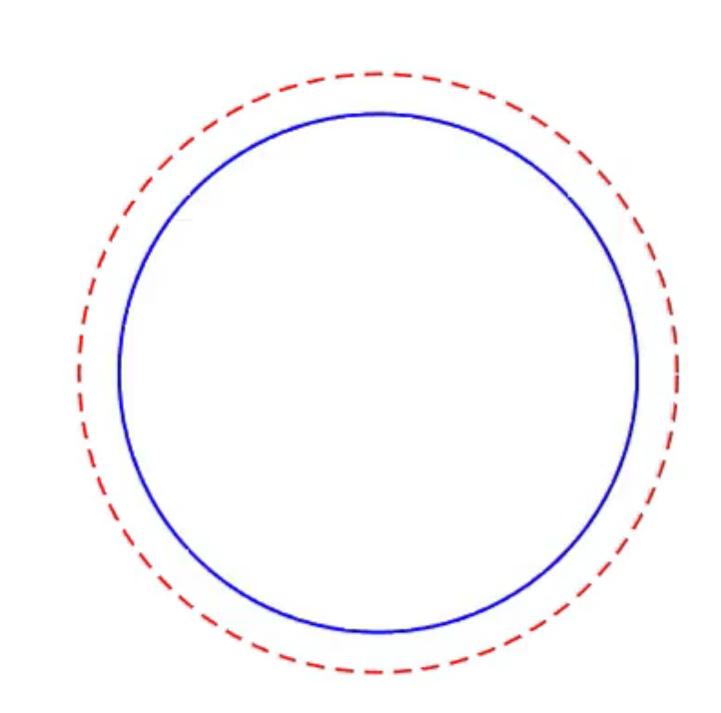
- DLP printed ELAST-BLK 10 elastomer Tensile specimen: ASTM D412 type C DOE process parameters & permutations:



### **Mechanical Testing**

- Instron 3365 extended-height load frame
- 2-kN load cell and long-travel extensometer
- ASTM D412 test standard
- Quasi-static (0.1 1/s)
- Room temp. and humidity

# **Dynamic Response of Spherical Membrane**

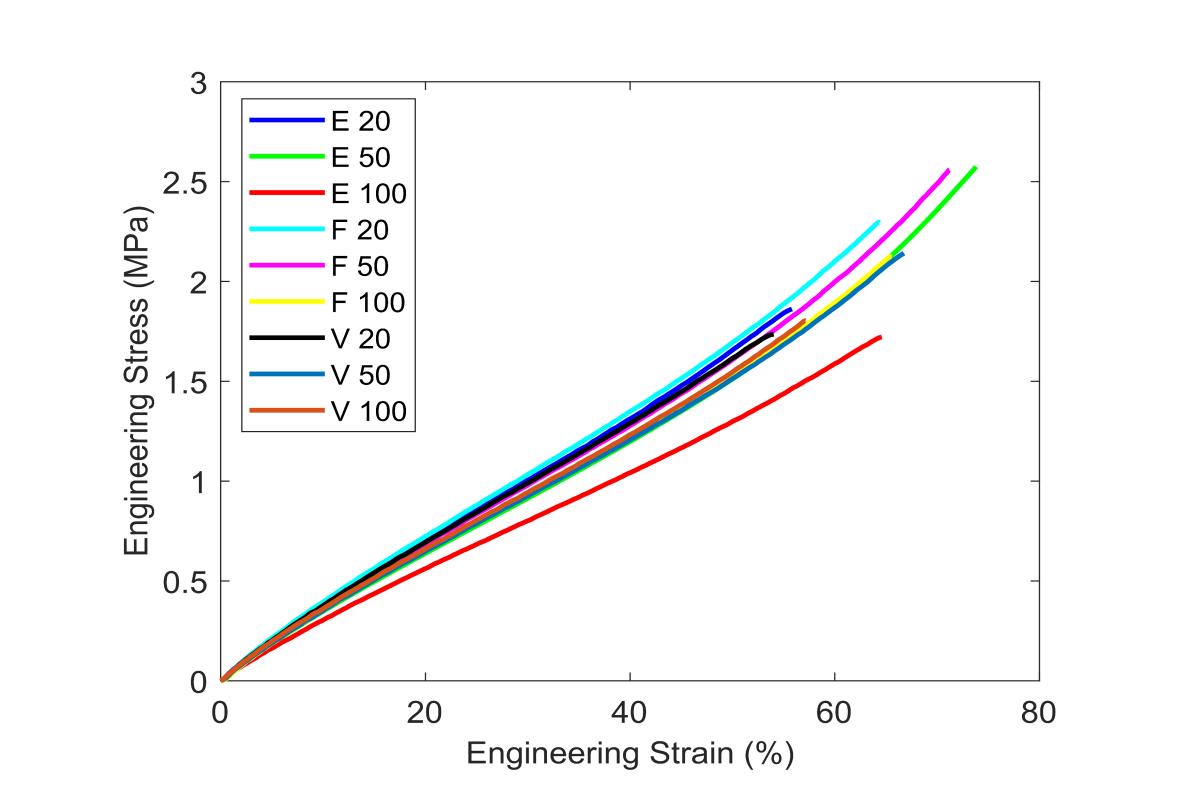


- is the

## Asma Ul Hosna Meem (M.S. Student)<sup>1</sup>, Dr. Robert L. Lowe (Advisor)<sup>1</sup>, Dr. Christopher Cooley<sup>2</sup>



- Flat-built tensile properties.



3.5

 $\lambda(t)$ 

2.5 gtr

1.5

- This video shows how the spherical membrane dynamically responds due a suddenly applied internal pressure.
- Oscillation about the equilibrium stretch occurs due to the presence of viscous damping, either from within the system or from the

environment.

#### Results

Decrease in layer thickness results in an increase in mechanical strength specimens have greater mechanical strength. Specimens built in vertical direction showed diminished

### Acknowledgments

Graduate Fellowship, MAE Dept., University of Dayton Kyle Rudolph, Allyson Cox, Tim Osborn, Austin Andwan

Mooney-Rivlin Model,  $\alpha = c_2/c_1 = 0.13$ , P<sub>i</sub> = 0.15, VDC = 0.2

