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Mechanics and Dynamics of Soft Additively Manufactured Elastomers with Extreme Stretchability

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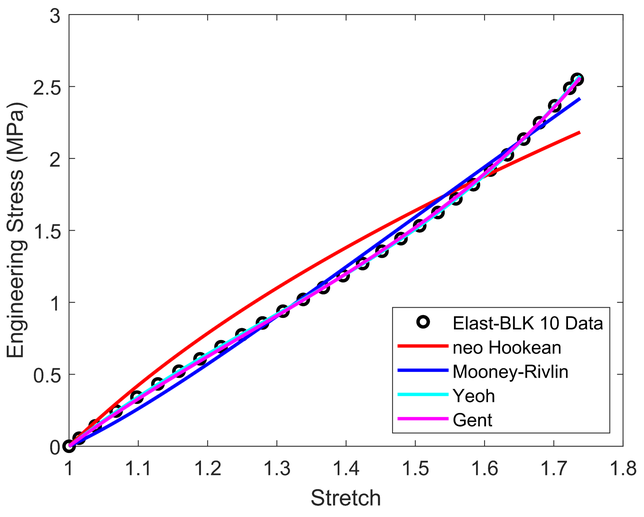
Introduction and Goals

- Additive Manufacturing (AM) is the 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

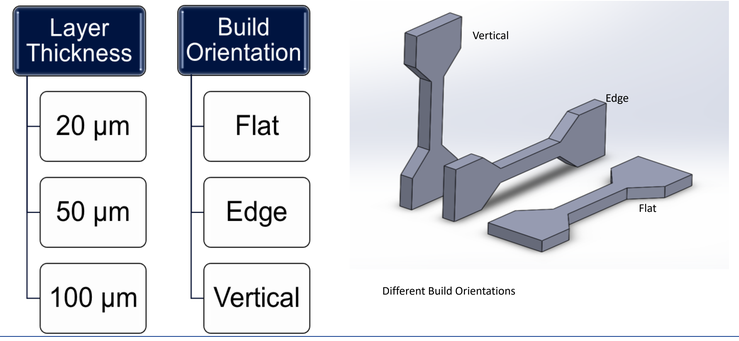
Constitutive Modeling

ELAST-BLK 10 Data Set



Materials and 3D Printing

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

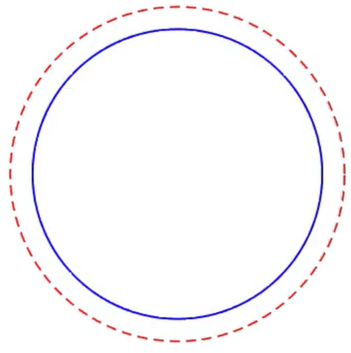


Different Build Orientations

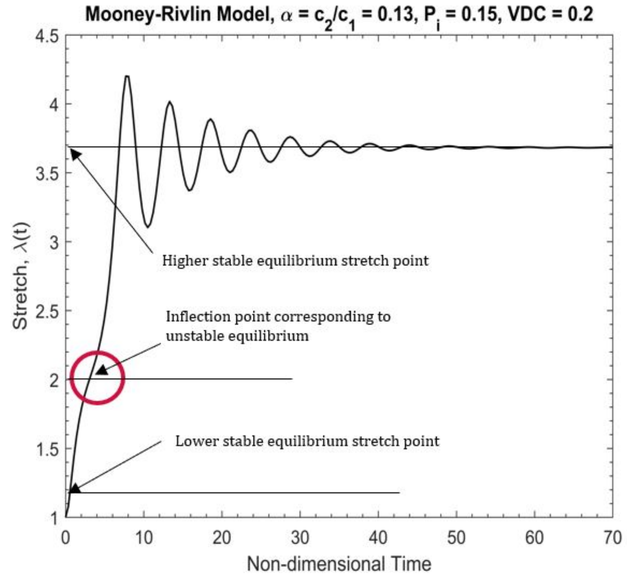
Mechanical Testing

- 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

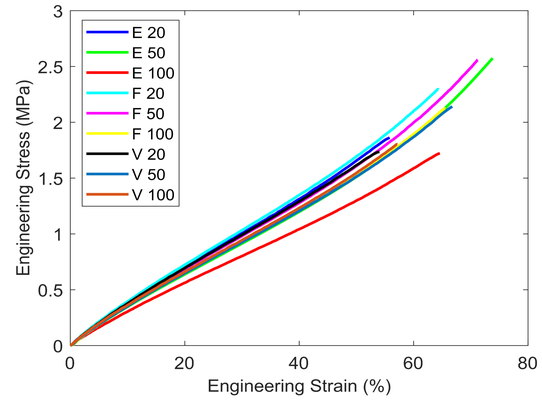


- This video shows how the spherical membrane dynamically responds due a suddenly applied internal pressure.
- Oscillation about the equilibrium stretch occurs due to the presence of viscous damping, either from within the system or from the environment.



Results

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



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