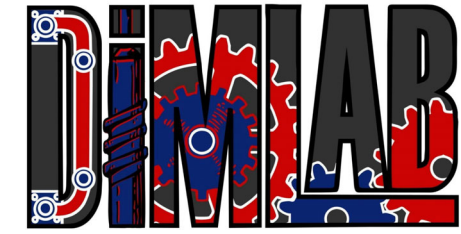


Establishing Soft Robot Modeling and Simulation Fundamentals to Drive Smart Nozzle Design

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Objective: Establish a correlation between Solidworks simulation data and tensile testing stress strain curves to reliably predict smart nozzle design actuation. Using UDRI's digital light processing (DLP) printers, test materials and smart nozzle designs can be rapidly created to test and validate simulations and prototypes.

Soft Robotics Background

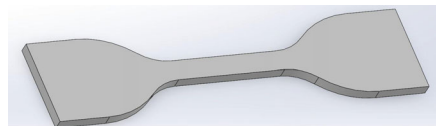
- Area of robotics which utilizes flexible materials
- Created out of polymers, urethanes, hydrogels and other manipulatable materials
- Elastic properties of elastomers allow for rotational and translational actuation
- Actuated thermally, pneumatically and electrically
- Applications in industrial and biomedical settings



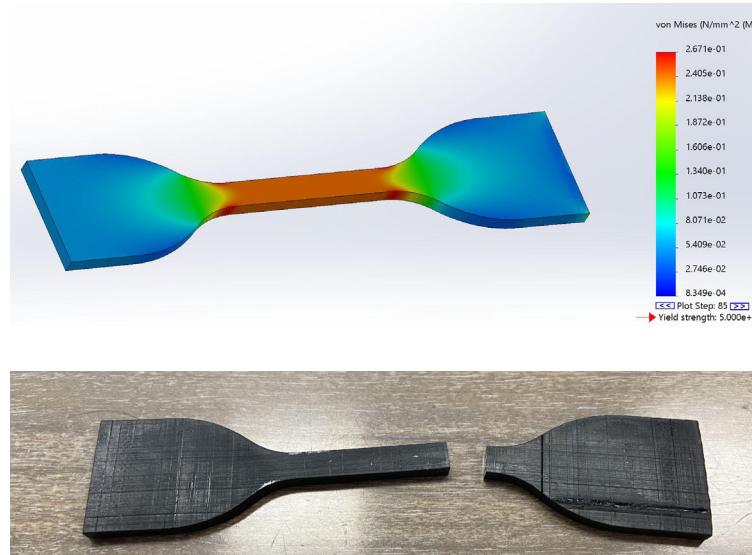
Source: <https://www.asme.org/topics-resources/content/seven-big-advances-in-soft-robotic-grippers>

DLP Printing

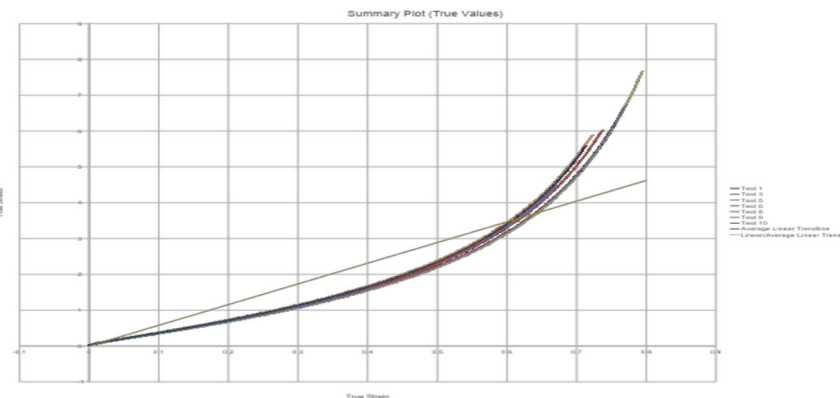
- Additive manufacturing technique
- Polymerizes a layer of resin using light
- Allows for rapid prototyping with elastic materials



Simulation Validation

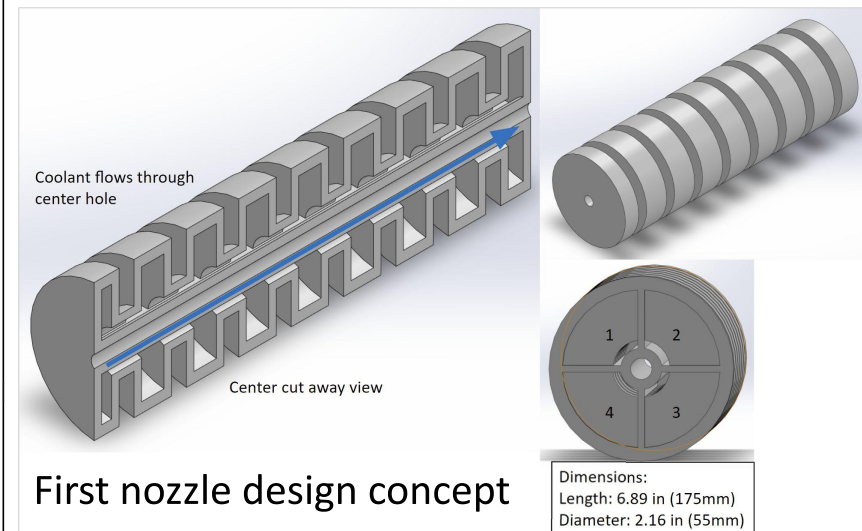


- Tensile tests simulated using Solidworks FEA
- Tensile testing carried out on DLP printed specimen using an Instron

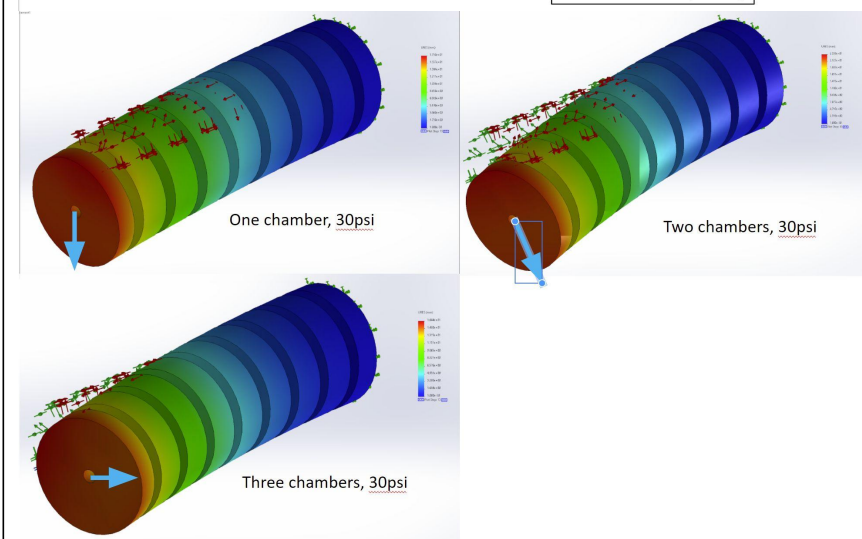


- Graph of all test data points with average linear fit applied
- Replicate linear behavior using linear elastic models in Solidworks

Modeling and Design



First nozzle design concept



Second nozzle design concept

