Soft Robot Actuator Design for Digital Light Processing

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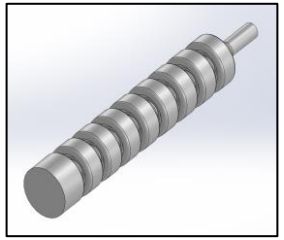
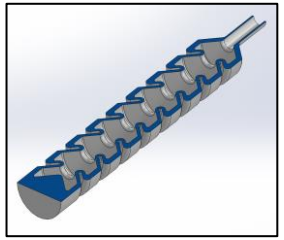
Objective: Design and simulate various soft robotic actuators to mimic primitive motions, including twisting, bending, elongating, and angular displacement. Utilizing UDRI's digital light processing (DLP) fabrication techniques, actuators can be prototyped and simulation results can be validated.

Soft Robotics Background:

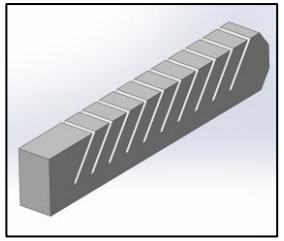
- A type of robotics pertaining to the use of highly compliant materials with inspiration taken from living creatures.
- Usually implemented as a soft polymer.
- Low rigidity allows for various configurations to be achieved.
- Very nonlinear and large displacements.
- Potential fields of application include biomedical, industrial, and search/retrieval.

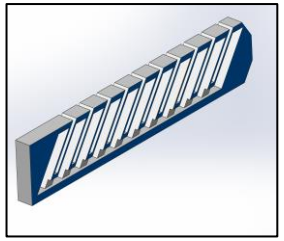
I. Actuator Concepts



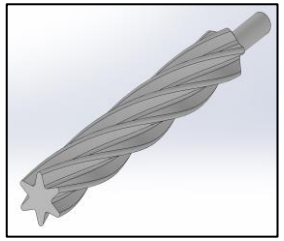


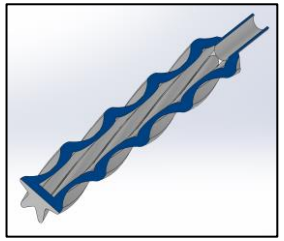
Extending actuation model demonstrates a linear translation. (similar to a prismatic joint).





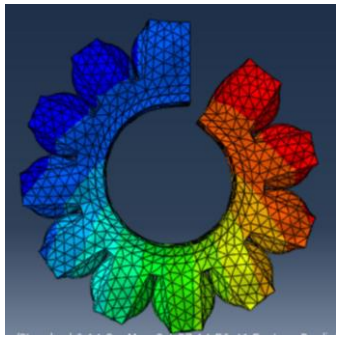
Bending actuation model demonstrates a curvilinear displacement. Can allow for a potential 360° range of motion





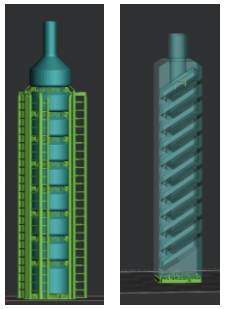
Twisting actuation model demonstrates an axial rotation motion. Approximately allows for 8-10° of twist.

II. Simulation



An ABAQUS FEA simulation of a bending actuator requires nonlinear considerations of high-strain compliant materials.

III. DLP Analysis



DLP additive manufacturing analysis indicates the support material that is required during printing. Shown to the left are bending and extending actuator models with support material in green.