Folded-Tube Membrane Soft Pneumatic Actuators, Initial Work

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Folded-Tube Concept

Enables large, high-torque bending actuators to be formed from a single section of off-the-shelf tubing.

These actuators can create large bending torques even at low pressures and are not antagonized by elastic forces.

Fabrication

Folded-tube actuators can be created without the need to cut and weld complex membrane structures.

a) Slits are cut into a strip of high-strength fabric to create the strain-limiting layer
b) A section of “layflat” tubing is cut to length
c) Twine is inserted through the interior of the tube to ensure air flow across folds
d) Folds of an appropriate height are formed
e) The folds are inserted through the fabric slits
f) The ends of the tube are closed with thin clamps

Working Principle

The bending moment comes from the physical interference of the folds. The largest possible contact area is the rectangular area of the fold.

Model

Our model assumes constant curvature in the actuator.

The bending moment approximation comes in part from a simplified geometric approximation of the fold contact areas.

Experimentation

Tension tests of the actuator assemblies were carried out at relatively low pressures.

As expected, increasing the number of folds per unit length increased the bending moment.

Other Work, “Vacuum Bellows”

Modeling Vacuum Bellows Soft Pneumatic Actuators with Optimal Mechanical Performance


Other Work, “Vacuum Bellows”

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