NRI: FND: COLLAB: A Foundational Approach to Muscle Actuators that Lowers Barriers to Muscle-Powered Robotics Research

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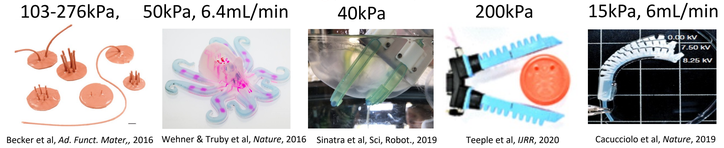
Overall goal: explore accessible soft actuator technologies, characterize their performance, and develop new designs, design and fabrication guidelines, and new uses

This poster: one example we have been studying: electrical control of soft fluidic artificial muscles

Motivation: Soft Fluid-driven Robots

Fluidic robots need to be tethered to rigid and bulky power sources

Objective: A Soft Valve



Lightweight and compact

Able to regulate pressure >10kPa

Able to provide flow rate >6mL/min

Response time << 2s

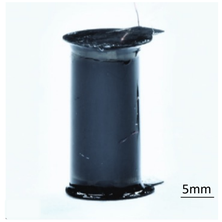
Electrically responsive

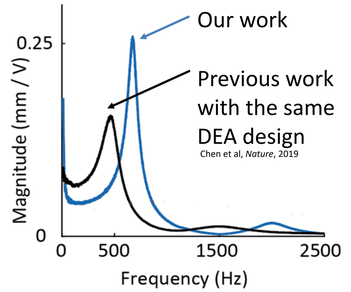
Basis: High Power Density DEA

Elastosil P7670 ⟶ Low viscoelasticity and high dielectric strength

$$p = \frac{F\delta}{2m} \cdot f$$

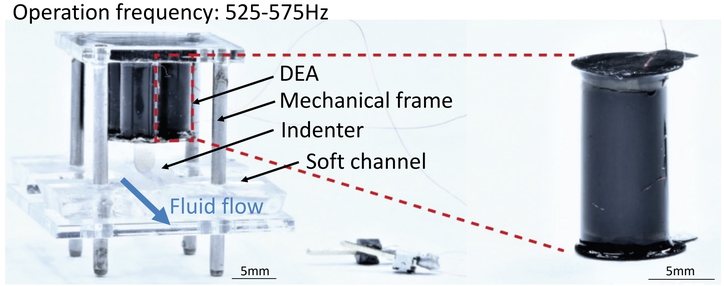
F: blocked force
δ: free displacement
f: frequency





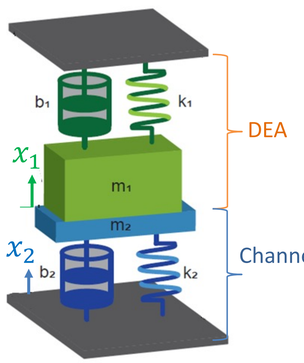
Dynamic DEA-valve

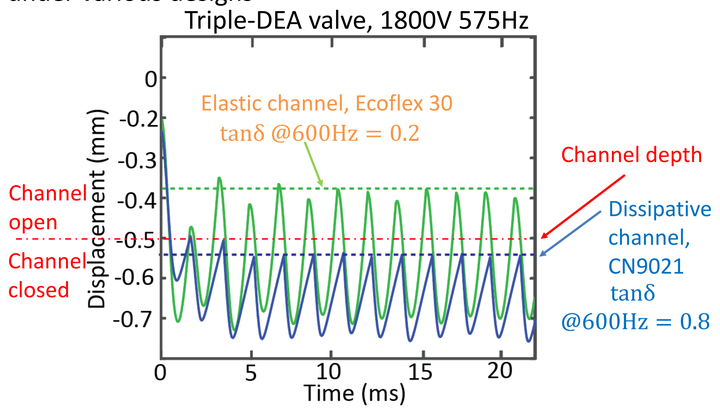
Operation frequency: 525-575Hz



Dynamic Analysis: Euler Lagrange Equations

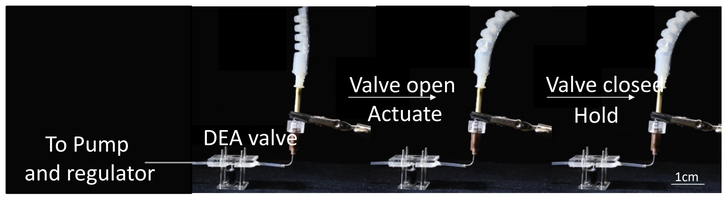
Predict valve performance under various designs





Demonstration: Control of hydraulic actuators

Maximum power consumption: 1.1 W
Efficiency: 9%
Operating frequency: 575Hz
Weight: 5.6g



Contributions

The first **electrically-controlled** soft valve based on **high power density DEAs** that realized **open- and closed-loop control** of hydraulic actuators of multiple scales.

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