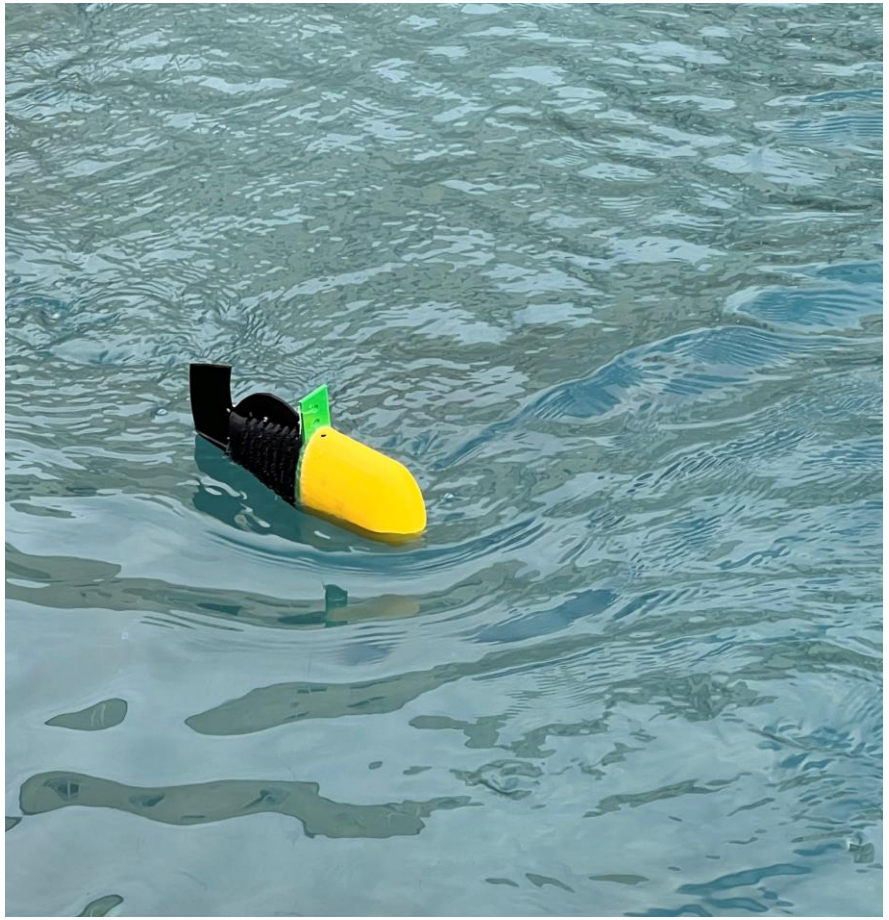
Portfolio

Michael da Silva

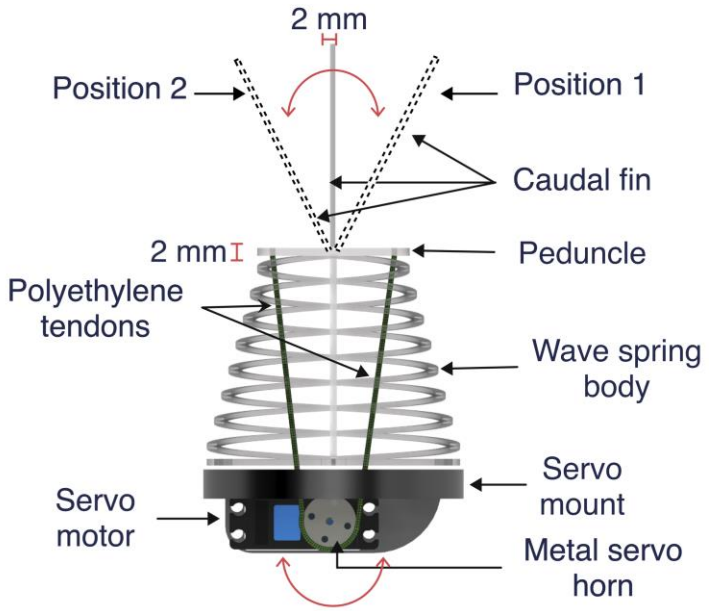
Cordelia

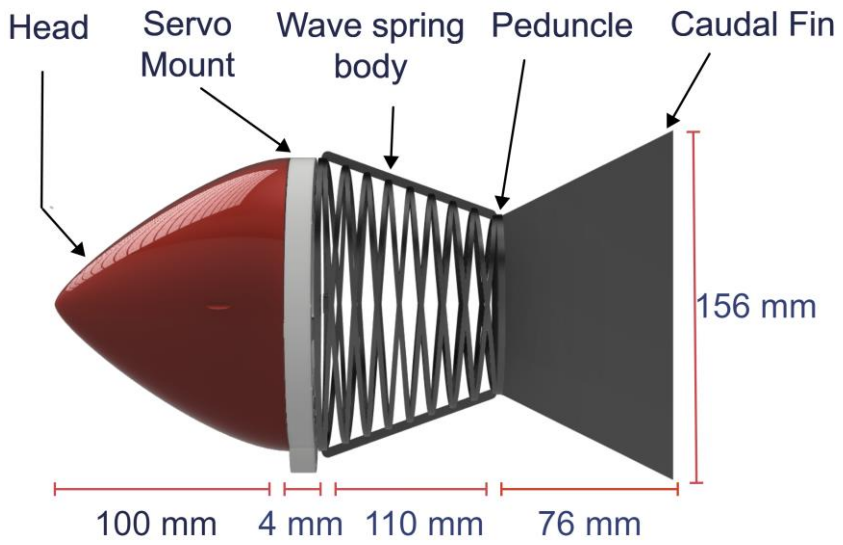
A biomimetic fish to monitor ocean temperature

Overview



- Cordelia is a robotic fish designed using a novel “wavespring” geometry.
- Modular geometric design enables oscillation and undulation locomotion gaits.
- The robots are 3D-printed using TPU with a shore-hardness of 85A and wrapped with latex to maintain buoyancy.
- Project Videos:
  - https://vimeo.com/850378372
  - https://vimeo.com/795958609



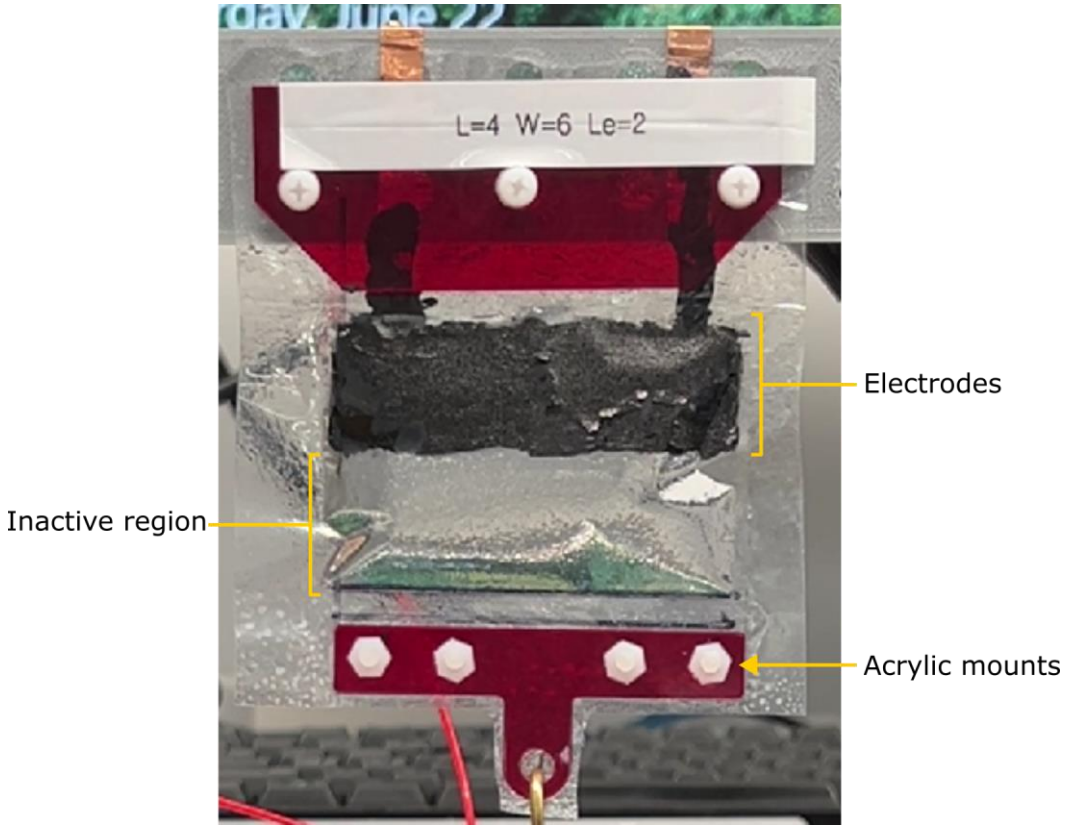


Latex-Wrapped for Compliance and Waterproofing

Electrohydraulic Haptic Muscles

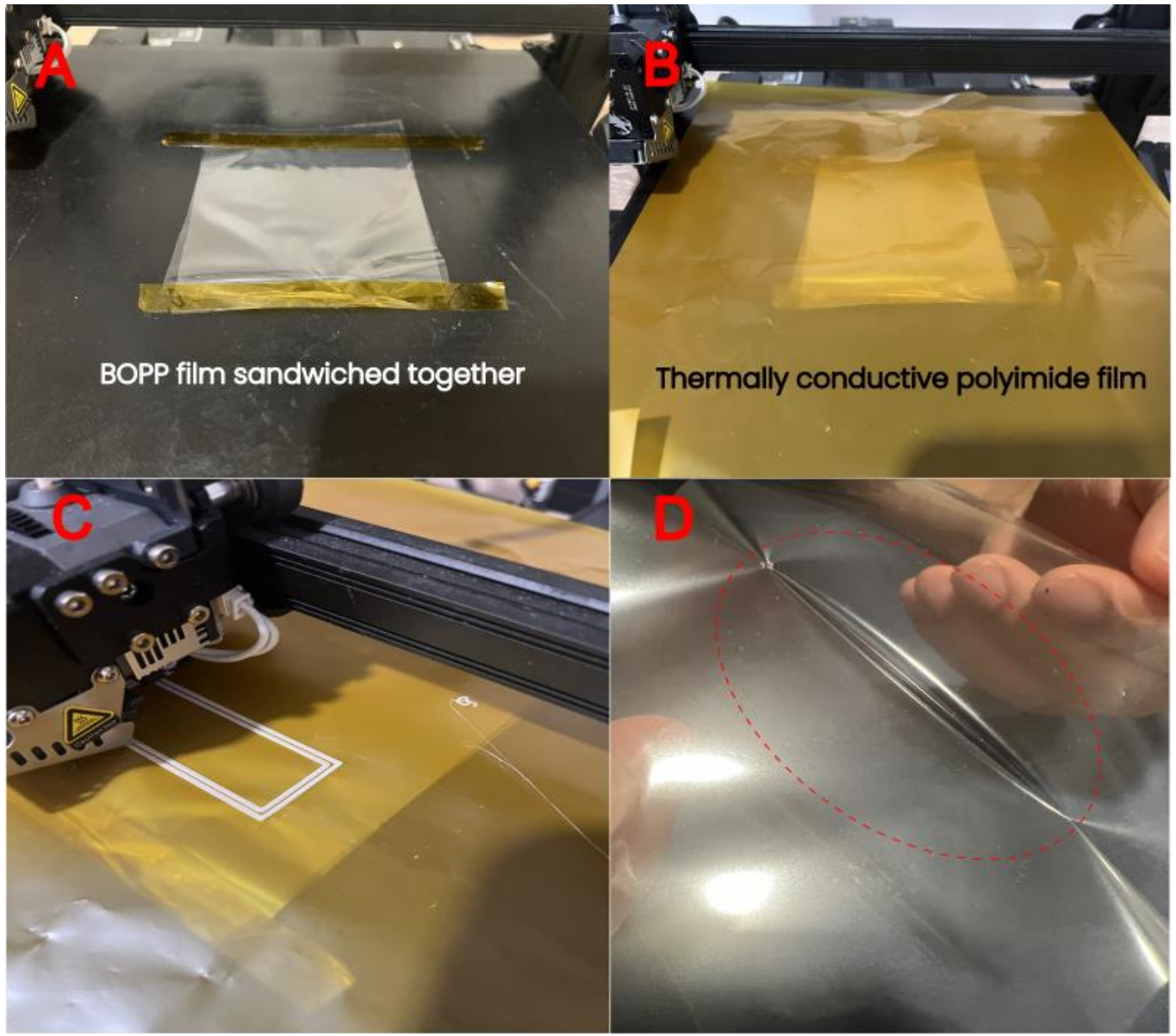
Toroidal haptic muscles for kinesthetic feedback

Overview

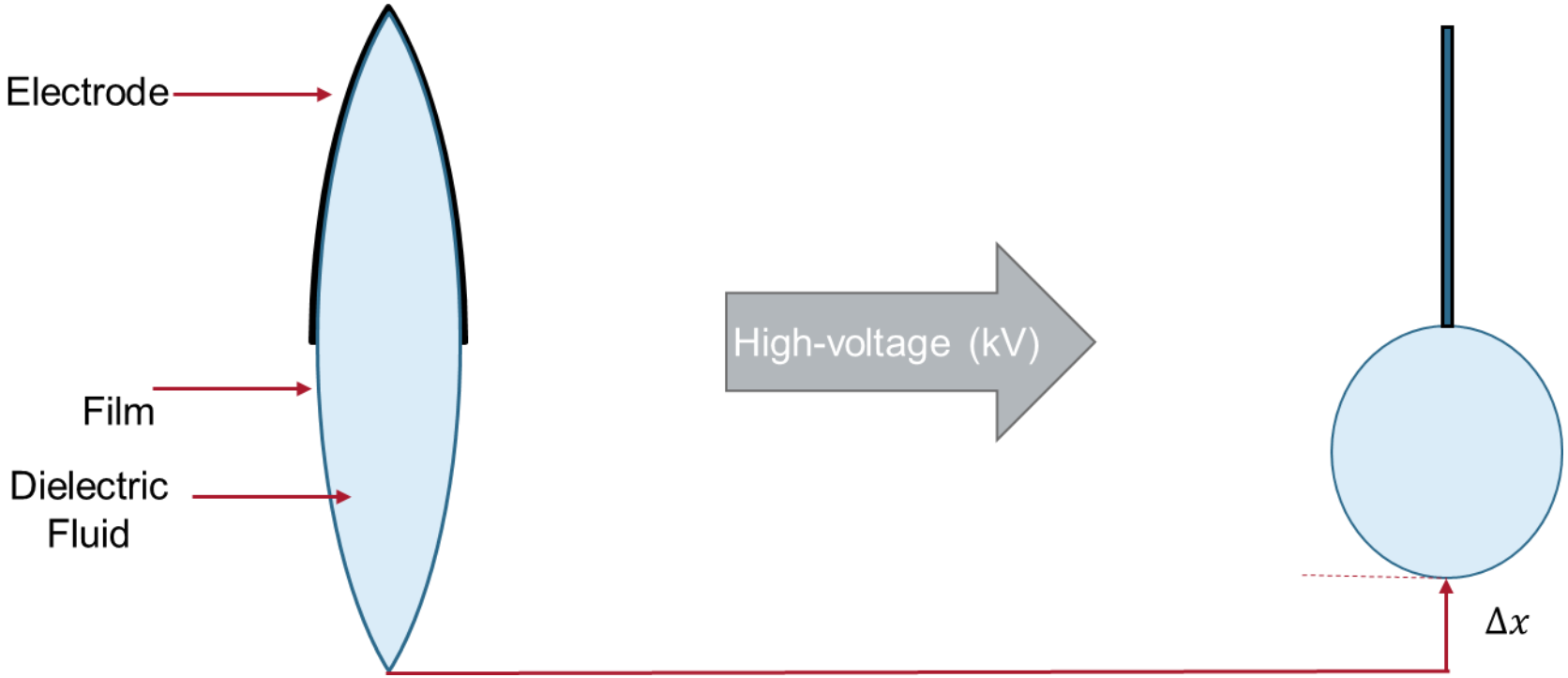


- Developed **electrohydraulic haptic muscles** integrating electrostatic actuation with hydraulic force, providing an alternative to traditional pneumatic muscles.
- Designed an **actuator system** that mimics human tendon motion, utilizing electrostatic forces to move dielectric liquid within a hermetic, flexible pouch.

Fabrication Steps



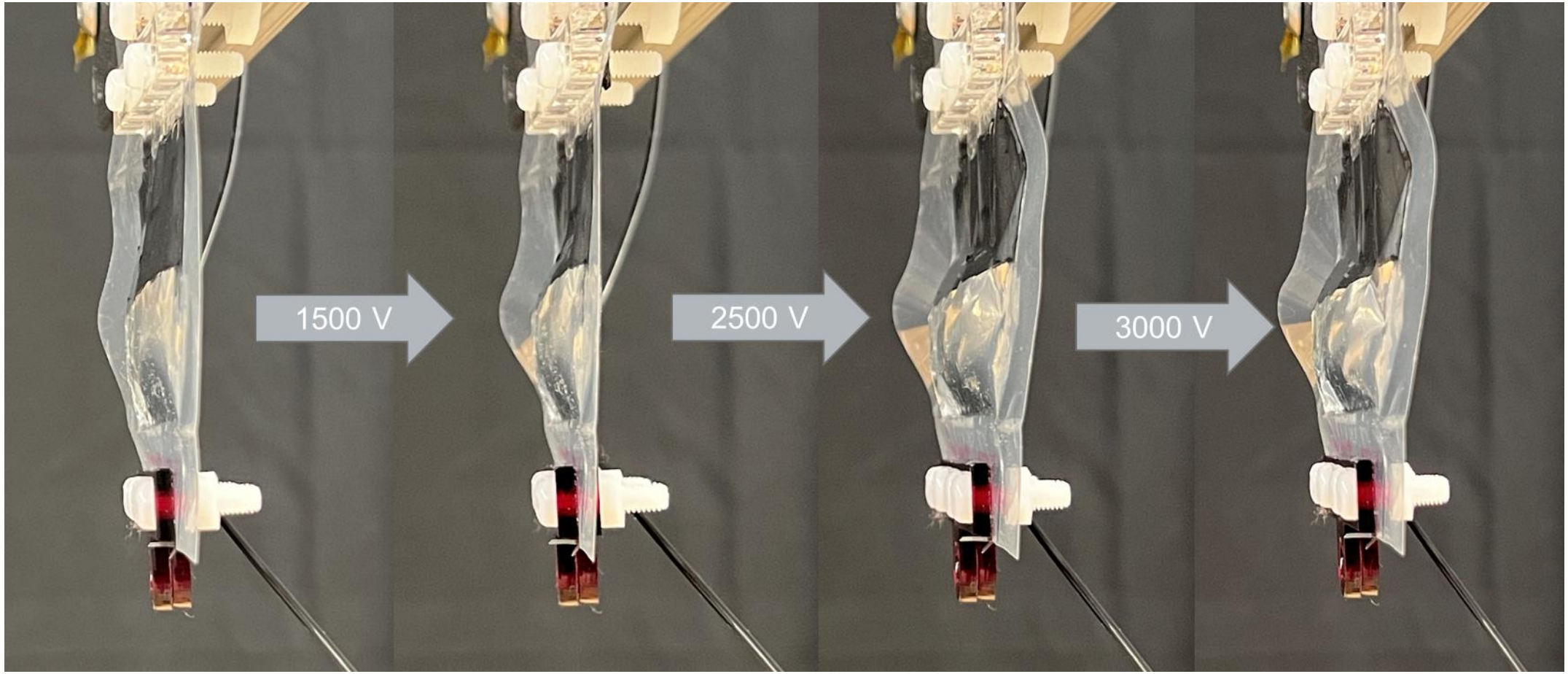
Zipping Actuation



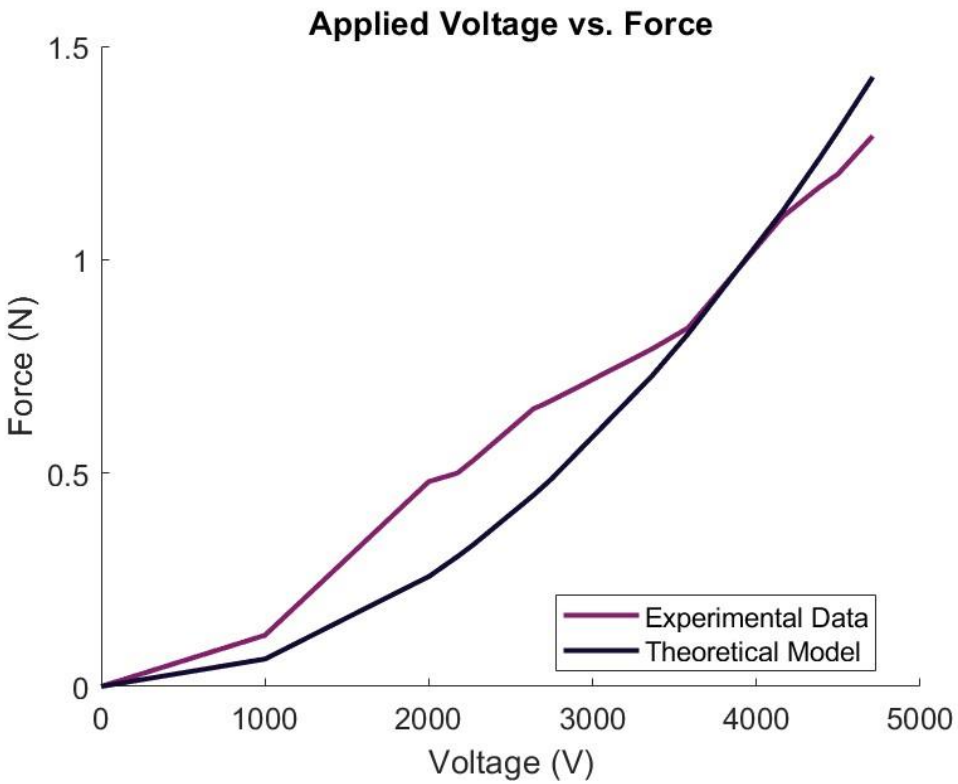
At rest, actuators take on an airfoil shape

Upon complete actuation, all the fluid is pushed into the area not covered by the electrode.

Zipping Actuation

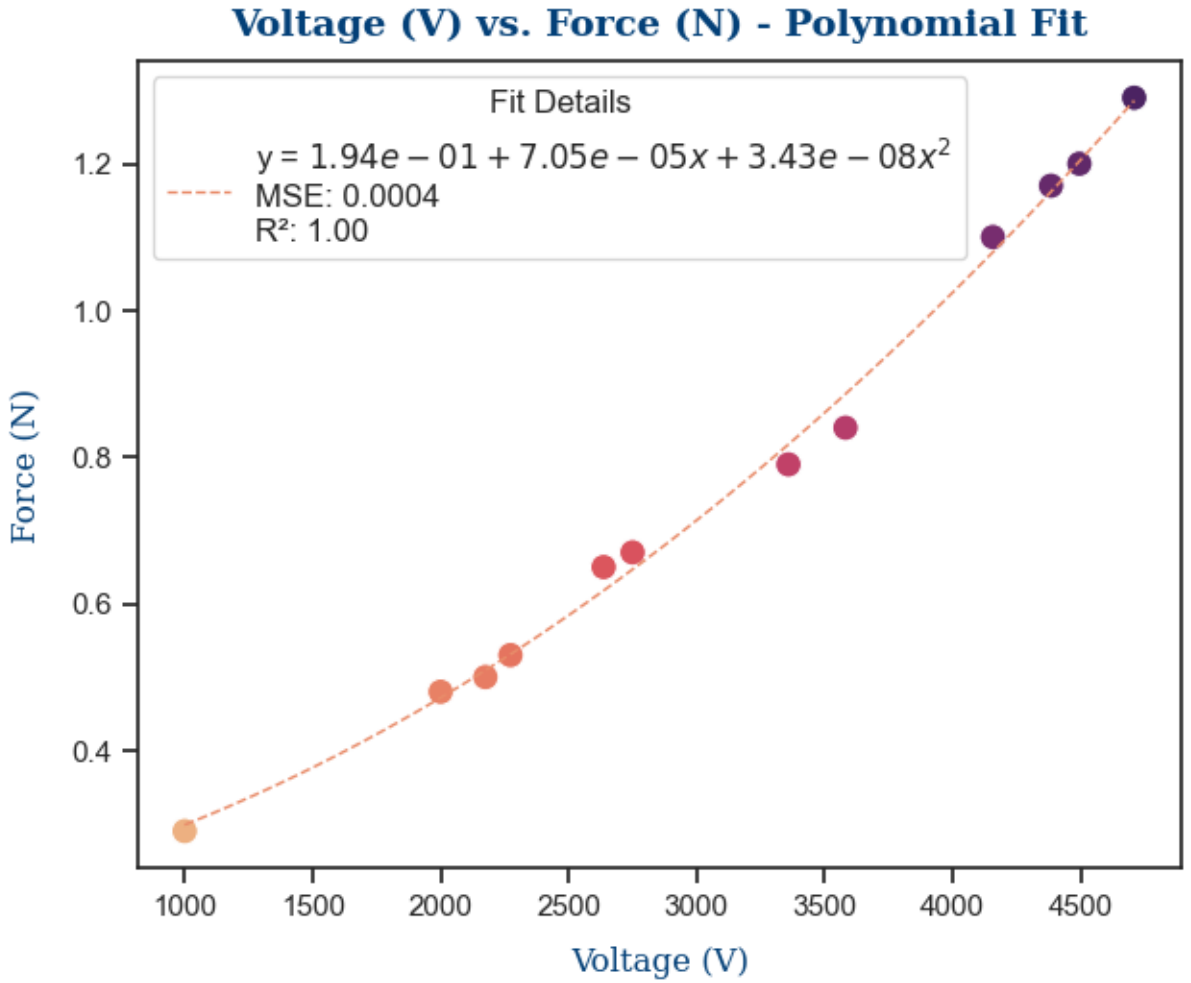


Voltage vs. Force



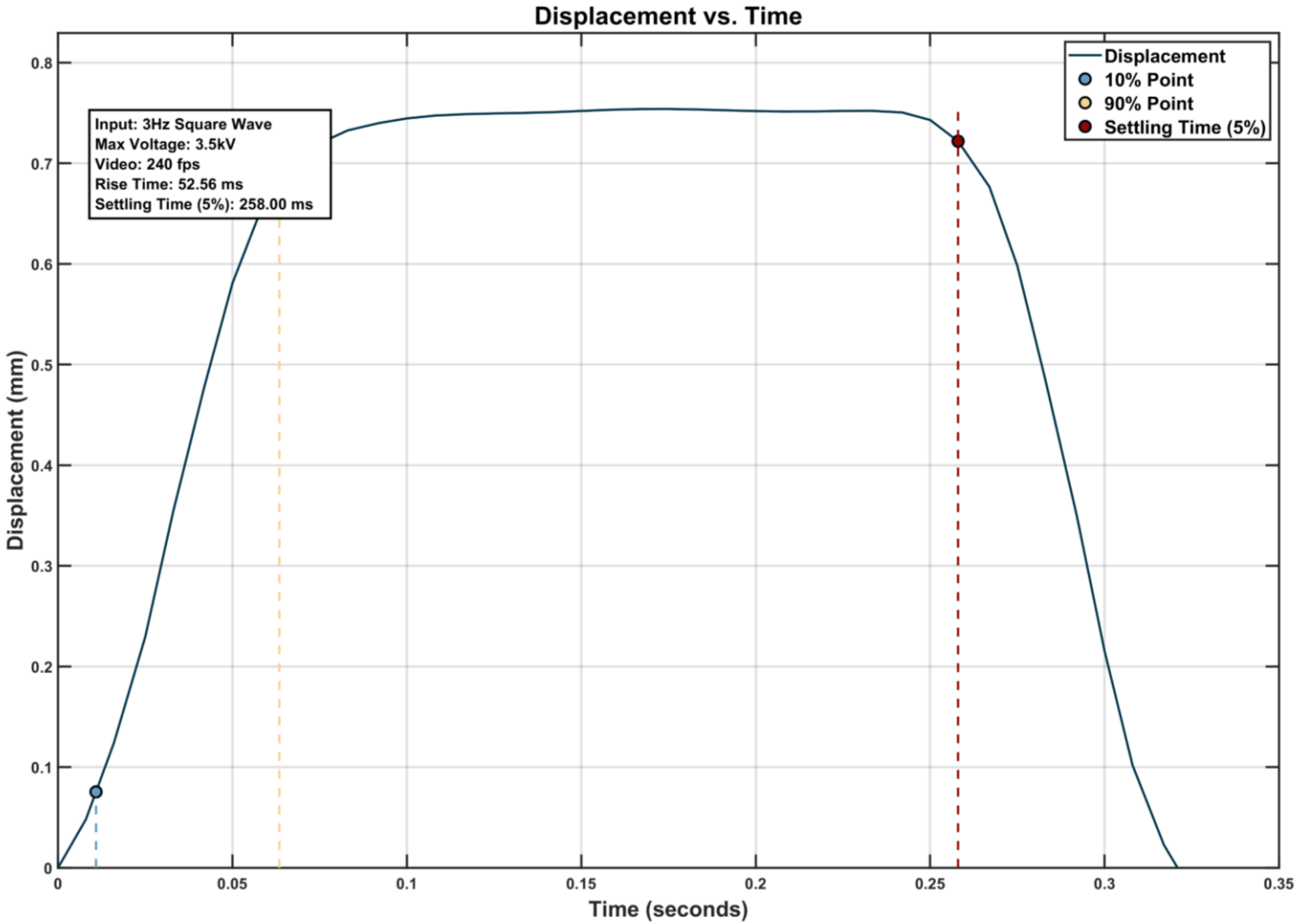
Force depends on Maxwell's stress

$F \propto \epsilon_0 \epsilon_r E^2$



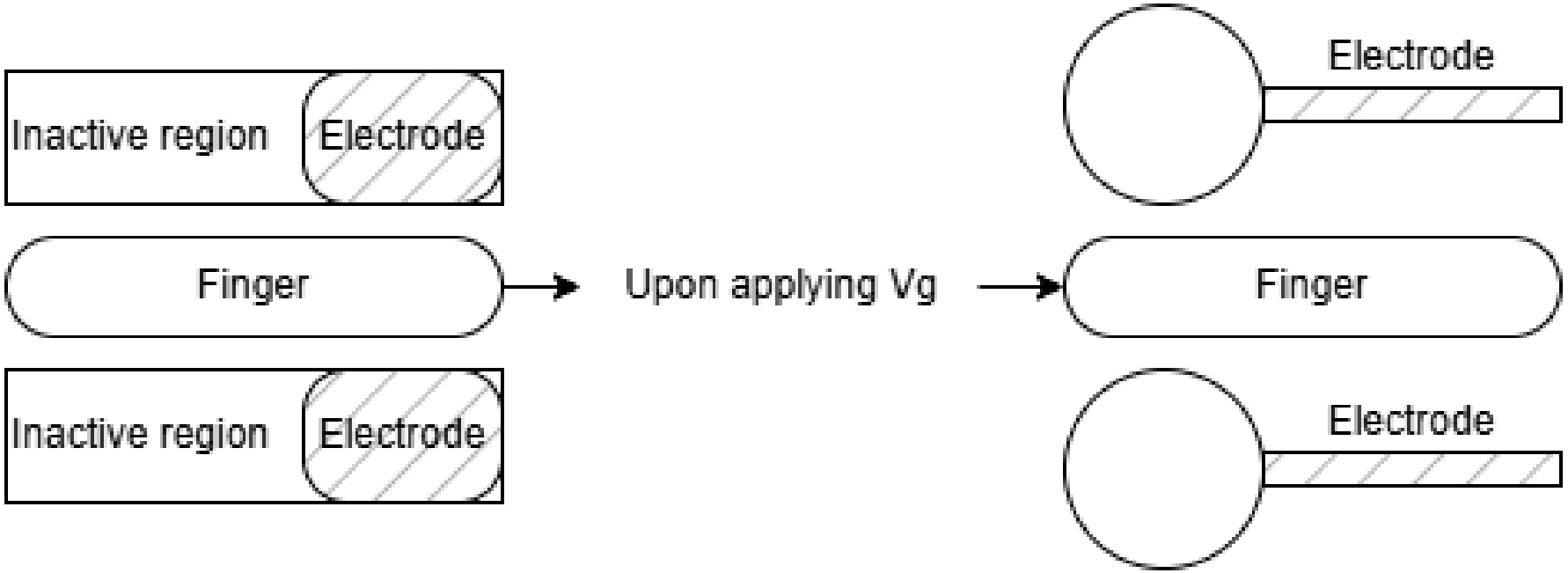
The fit indicates an almost linear relation between voltage and force

Transient Analysis



- Rise time = 52 ms
- Settling time = 258 ms
- Critically damped system

Toroidal Haptic Muscle

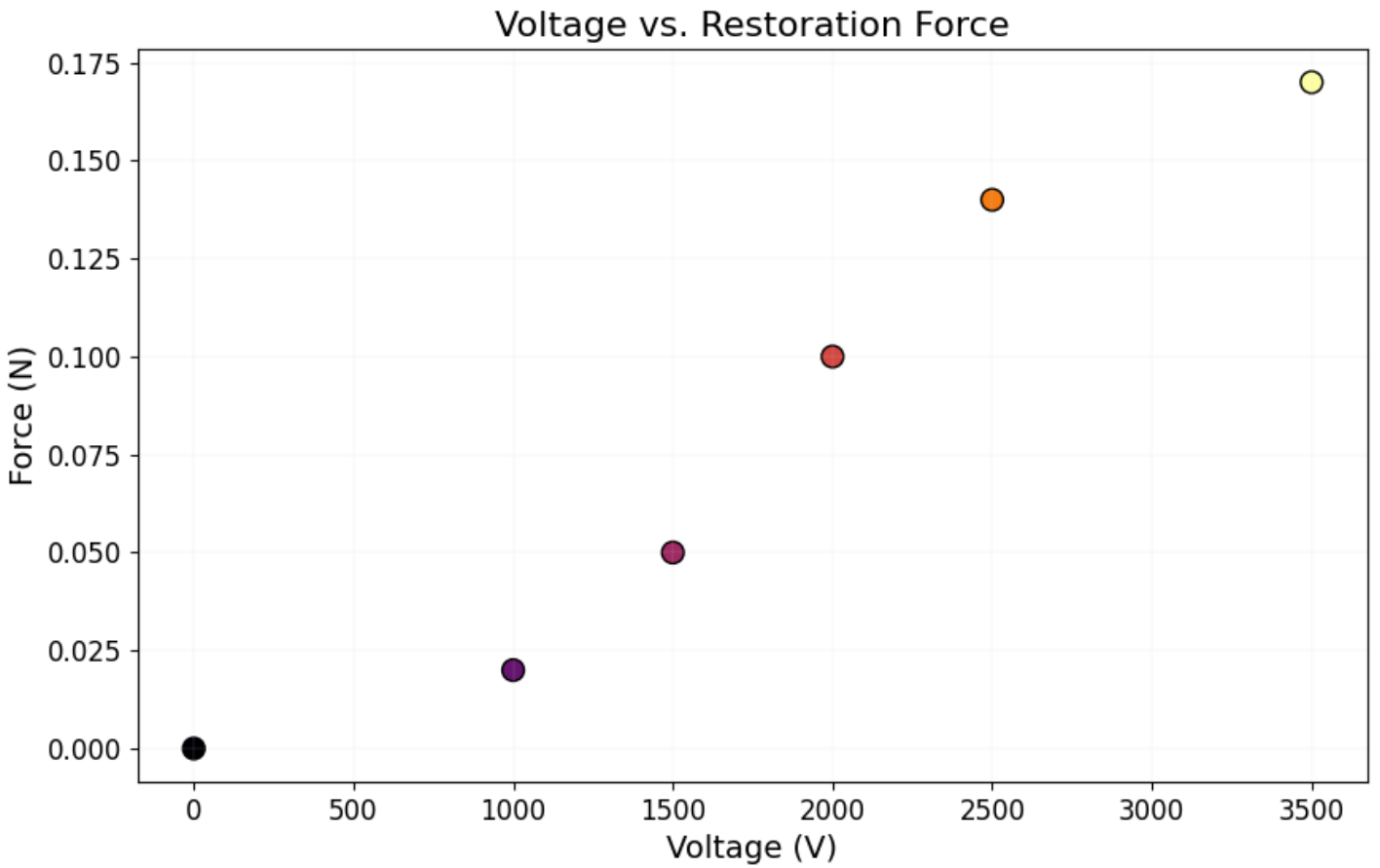


Toroidal Haptic Muscle

Side View

Haptic Muscle upon actuation

Restoration Force

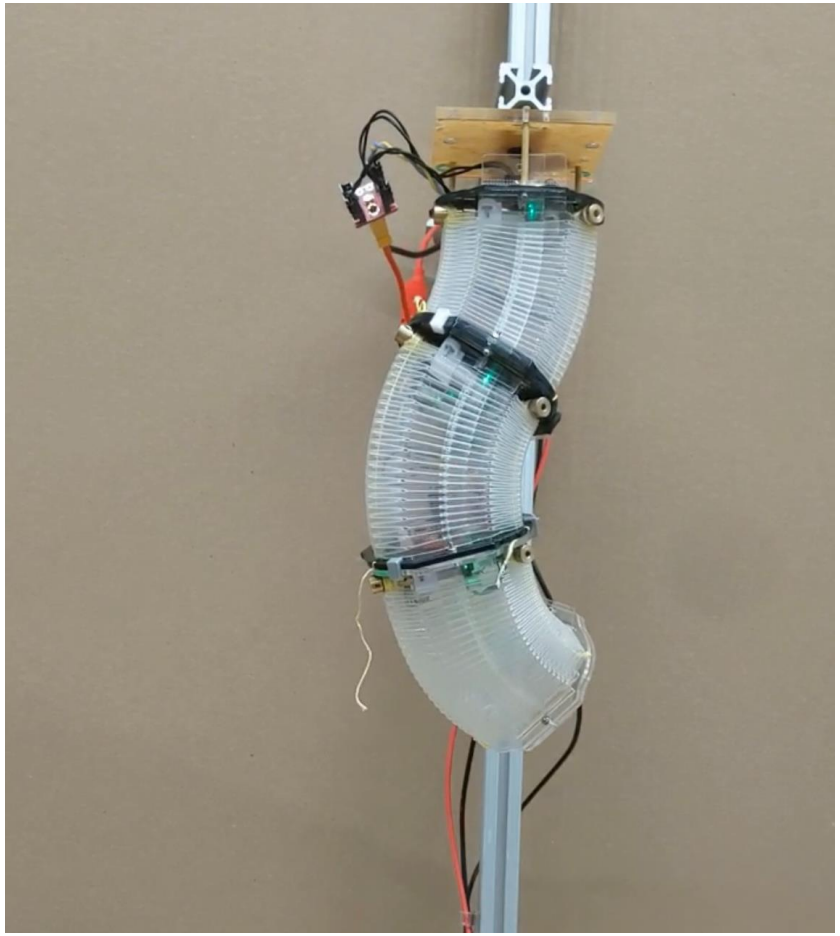


Voltage controlled force feedback

Origami-inspired continuum arm

Inverse kinematics solver

Origami-inspired continuum arm



- Continuum arms are robotic arms that are more flexible and safer than traditional stiff arms. They can reach tight spaces and move around obstacles easily.
- This innovation opens up new possibilities for robotic applications in confined and populated environments, enhancing safety and operational efficiency.
- The creation of an analytical solver for the continuum arm was recognized through publication at the 18th International Symposium on Experimental Robotics (ISER 2023).
- Project Video:
  - https://vimeo.com/918966883