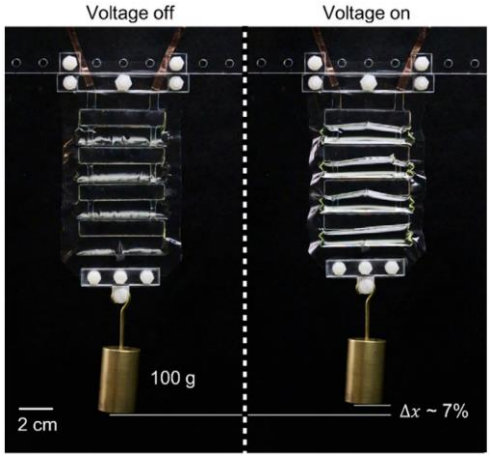
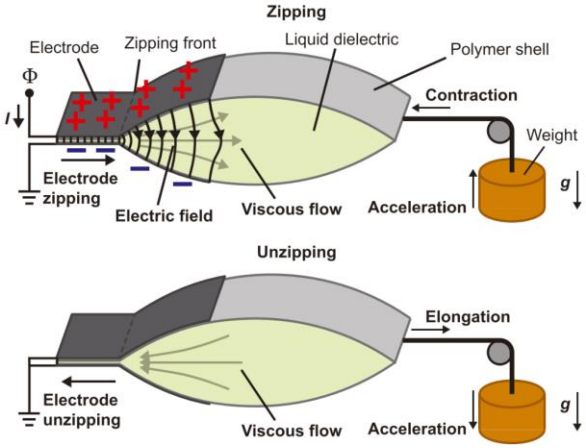
University of Stuttgart
Institute for Adaptive Mechanical Systems

Master's thesis

Thesis Title:
Finite element simulation of the zipping process in electrohydraulic actuators

Description:
HASEL (Hydraulically Amplified Self-healing Electrostatic) actuators are a new class of artificial muscles that comprise liquid-filled deformable pouches that are coated with electrodes. When a high voltage is applied between the electrodes of a HASEL actuator, the electrostatic attraction causes the walls of the shell to zip together and the actuator to deform. Applications for these artificial muscles include bioinspired robots, lifelike prosthetics, and medical devices. To date, the interplay between electric forces and the mechanics of the muscles is not understood. Developing this understanding is important to explain experimental observations, to design actuators, and to improve their performance in the future.





You are asked to develop a detailed multiphysics finite element simulation of the region near the zipping front, which couples mechanical and electrical effects and validate the simulation with experimental data. The main tasks of the thesis will be

1. Setting up a finite element simulation of the mechanical behavior of the region near the zipping front including contacts and geometric nonlinearities using COMSOL
2. Coupling the mechanical simulation with a finite element simulation of the electric fields in the zipping region
3. Validation of the model through experimental data
4. Carrying out a parametric study to investigate the influence of geometry and materials parameters on the zipping behavior.

The project will be carried out in collaboration with the Robotic Materials Department at the Max Planck Institute for Intelligent Systems in Stuttgart.

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