Modelling and Simulation of EAP
Investigation of Electroactive Polymers (EAPs) for Intrinsic Actuation of Flexible Instruments for Medical Applications — 20th February 2021 —

Context
For minimally invasive neurosurgery, complex, flexible snake-like instruments are developed. To optimise actuation alongside with the necessary degree of miniaturisation, materials with intrinsic actuation are investigated, such as Electroactive Polymers (EAPs). These materials deform when a voltage is applied. To utilise them for actuation purposes, their physical-mechanical behaviour must be understood.

Figure 1: Utilisation of a snake-like instrument to approach a lesion in the human brain avoiding damage to non-involved tissue. Source: MTU Aero Engines (modified).

Objective
This work will investigate the behaviour of an EAP sample by creating a simulation model which is then validated in physical experiments.

Task Summary
- Review literature for modelling ionic EAPs.
- Find an appropriate model and discuss simplifications if necessary.
- Implement a simulation model using a programming language of your choice.
- Create or modify a user-friendly simulation tool and an easy-to-use documentation or video tutorial.
- Validate the simulation results on an EAP sample in a physical experiment.
- Discuss possible optimisations of the simulation model and the experimental setup.

Requirements
Qualified candidates (material science, physics, engineering, computer science) shall be interested in:
- Interdisciplinary challenges
- Model design
- Multi-physical simulation
- Experimentation

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