Karlsruhe Institute of Technology

Institute for Anthropomatics and Robotics - Health Robotics and Automation
Jun.-Prof. Dr. Franziska Mathis-Ullrich
Building 40.28
http://www.hera.iar.kit.edu

Health Robotics and Automation

Modelling and Simulation of EAP

Investigation of Electroactive Polymers (EAPs) for Intrinstic Actuation of Flexible Instruments for Medical Applications

— 20th February 2021 —

Bachelor's or Master's Thesis

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.

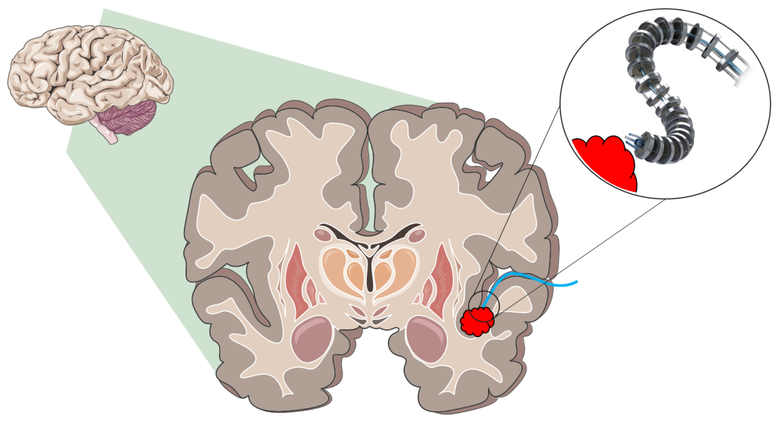

Figure 1: Utilisation of a snake-like instrument to approach a lesion in the human brain avoiding damage to non-involved tissue. Source: MTU Aero Engines (modified).

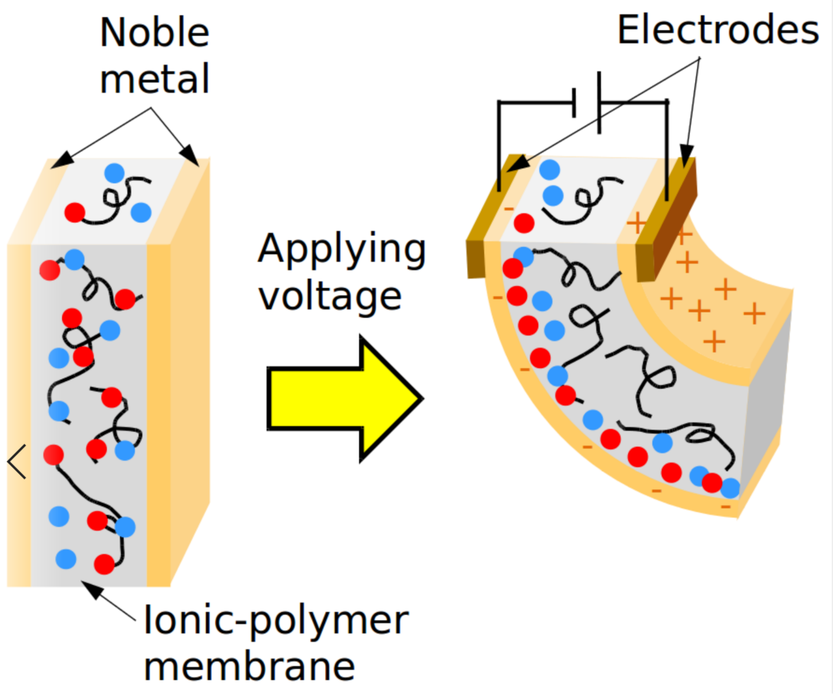

Figure 2: Functional principle of an ionic EAP performing a bending motion once voltage is applied.

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.

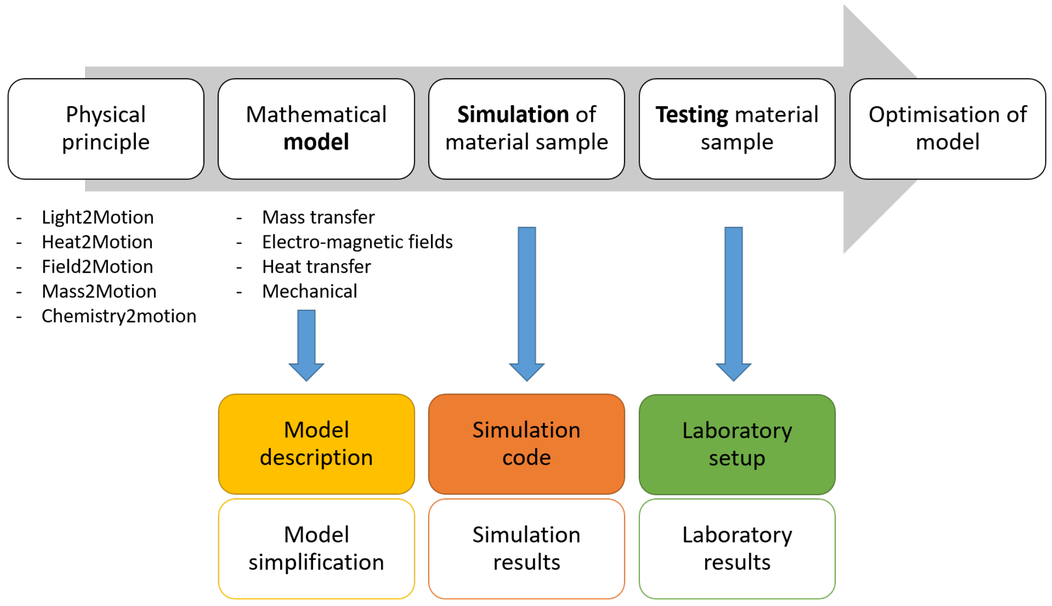

Figure 3: Generic workflow and its outputs to investigate "Smart Materials" using a simulation model.

Requirements

Qualified candidates (material science, physics, engineering, computer science) shall be interested in:

- Interdisciplinary challenges
- Model design
- Multi-physical simulation
- Experimentation

Contact

Nikola Fischer, M.Sc.
Building 40.28, Room 102
nikola.fischer@kit.edu
+49 721 608 - 44263