TECHNISCHE UNIVERSITÄT DRESDEN

Fakultät für Elektrotechnik und Informationstechnik Institut für Halbleiter und Mikrosystme

Professur für Mikrosystme

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Topic for student research / diploma / master project

Dielectric Elastomer Rolling Cylindrical Robot - DERoC

Dielectric elastomer artificial muscles (DEAs) are a highly promising actuator technology for soft robotics. They combine lightweight construction, large deformations, and energy-efficient actuation, making them well-suited for building compliant, bio-inspired robotic systems. A particularly exciting application is the development of cylindrical rolling robots driven entirely by soft artificial muscles, offering simple locomotion, adaptability, and high robustness.

The aim of this thesis is to design, construct, prototype, and experimentally evaluate a Dielectric Elastomer Rolling Cylindrical Robot. This includes the development of the overall soft robotic structure, the layout of suitable dielectric elastomer muscles, and their analytical as well as finite element modelling. The work will also cover the design and integration of mechanical, material, and actuation aspects into a functioning prototype, followed by experimental validation and performance evaluation. It is important to analytically understand the continuum mechanical behavior of dielectric elastomer actuators and how to design them. This requires a fundamental knowledge of mechanics. This project provides the opportunity to combine analytical modelling, finite element simulation, soft actuator design, and hands-on prototyping in one of the most dynamic areas of soft robotics research.

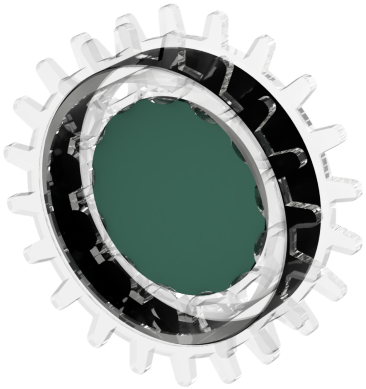

Figure: Sensor-integrating coupling with measuring electronics, enabling the implementation of a self-priming energy harvesting circuit

Focus of work

- Literature review on rolling soft robots and DEA-based actuation
- Analytical modelling of dielectric elastomer muscles and cylindrical locomotion principles
- Finite element modelling of the actuator–structure system
- Design and layout of the robot's soft body and integrated DEA muscles
- Fabrication and assembly of a functional prototype
- Experimental testing, documentation, and discussion of the results

Counterpart

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