

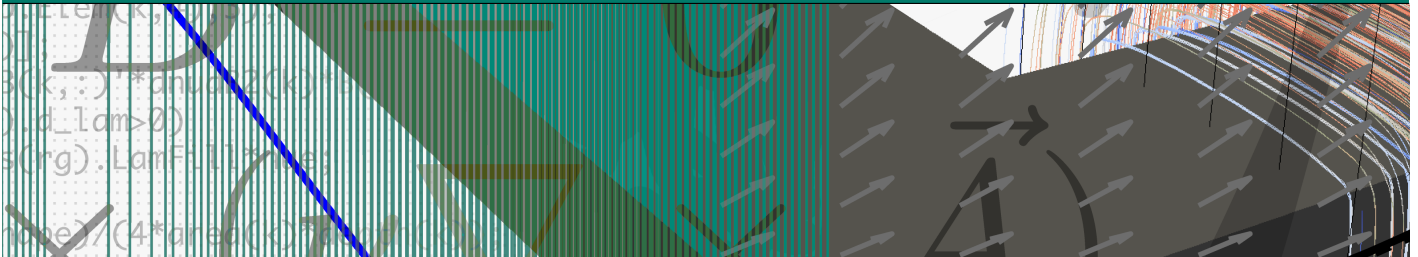
Modeling and Simulation of magnetolectric (ME) sensors using Isogeometric Analysis



TECHNISCHE
UNIVERSITÄT
DARMSTADT

Proposal for a Master's thesis

Study field: Computational Engineering | Computer Science | Electrical Engineering | Mathematics



Description

Due to their high sensitivity, magnetolectric (ME) sensors consisting of multiferroic composite materials have wide application areas, mainly focusing on the medical field, e.g. for measuring biomagnetic signals in the diagnostics of human brain or heart functions. These ME are based on composites with magnetostrictive and piezoelectric layers that are usually accompanied by a layer of substrate, made of e.g. silicon or steel. The modeling and simulation of such ME composite structures is particularly challenging as it involves partial differential equations that couple the electric, magnetic and mechanical fields.

The master thesis aims at extending already existing mathematical models to include the piezoelectric effect and simulating the resulting PDEs with the open-source solver GEOPDEs, which uses Isogeometric Analysis (IGA), a generalization of the Finite Element Method (FEM) based on splines that enables exact geometry description.

Contact:

Dr. Mané Harutyunyan
Prof. Dr. Sebastian Schöps

mane.harutyunyan@
tu-darmstadt.de
sebastian.schoeps@
tu-darmstadt.de

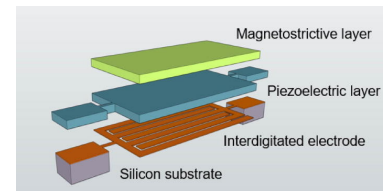


Figure 1: Structure of a ME composite (ref.)

Work plan

- Study the structure and operating mode of ME sensors.
- Understand magnetostrictive coupling and the corresponding PDEs.
- Understand the concept of Isogeometric Analysis.
- Get acquainted with the solver GEOPDEs and extend existing models to simulate ME sensors.

Prerequisites

A strong affinity to programming, experience with GEOPDEs (or the motivation to learn it on short term). Knowledge of FEM and general understanding of numerical schemes for the solution of partial differential equations. Affinity for mathematical concepts as well as for dealing with new challenging topics.