Mappings for Shape Morphing Applied to an Eigenvalue Tracking Method

TECHNISCHE UNIVERSITÄT DARMSTADT

Proposal for a Bachelor's thesis
Study field: Computational Engineering | Electrical Engineering | Mathematics
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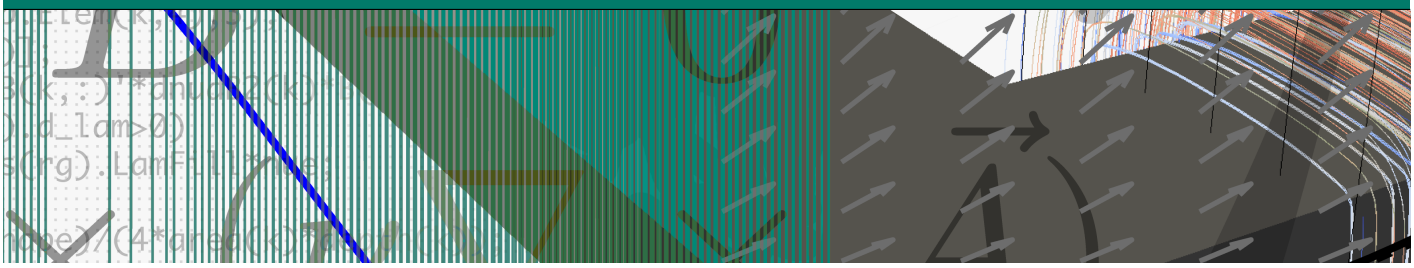

Description

The performance of accelerator cavities is evaluated based on their eigenmodes. Since the classification of their eigenmodes is cumbersome, we investigate automatic mode recognition by deforming the cavity geometry to an analytically well-known shape and tracking the eigenmodes during the deformation along a deformation parameter $t \in [0, 1]$ [1]. We compare two different mappings from the elliptical TESLA cavity (see Fig. 1, left) to the cylindrical pillbox cavity (Fig. 1, right). In the *physical* mapping, we model the shape morphing as depicted in Fig. 1 by assembling the geometry at intermediate shapes.

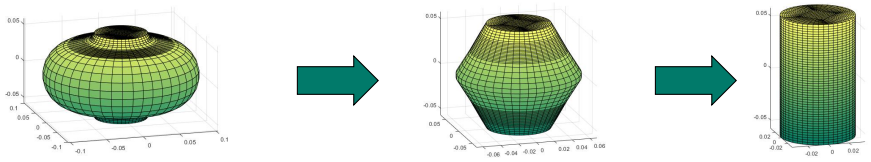

Figure 1: Shape morphing from the TESLA cavity (left) to the pillbox cavity (right).

In contrast, the *algebraic* mapping is formulated as a convex combination of the system matrices and hence intermediate results do not represent the solution of physical systems. However, both match the same frequency at $t = 0$ and $t = 1$, see Fig. 2.

The purpose of this thesis is to study and implement more mappings to detect the limitations of this algorithm and formulate the underlying assumptions on the mapping.

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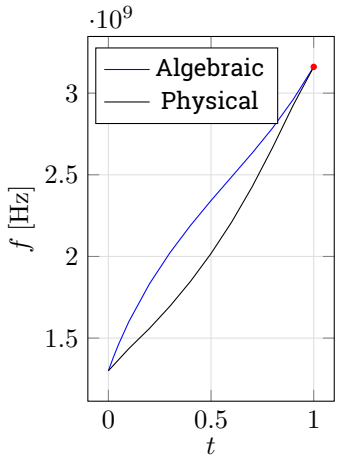

Figure 2: Tracking with both mappings yield same result.

Work plan

- Familiarization with the problem setting, Isogeometric Analysis and the existing implementation
- Construct mappings for the shape deformation for which the eigenmode tracking fails
- Deduce the underlying assumptions on the mapping

CEM

Prerequisites

Interest in numerical methods, basic knowledge of programming with Matlab.

References

[1] Ziegler, Anna; Georg, Niklas; Ackermann, Wolfgang; Schöps, Sebastian: *Mode Recognition by Shape Morphing for Maxwell's Eigenvalue Problem.* Cornell University, ARXIV: 2203.00499. 2022. Preprint.

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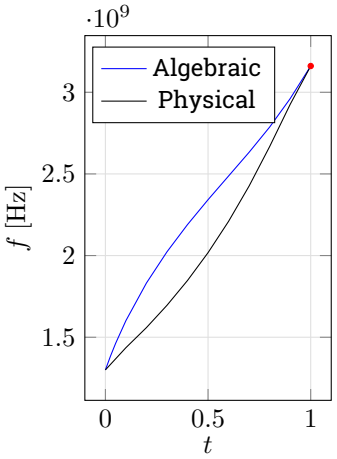

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