Conventional finite element method and isogeometric analysis: a comparison

BSc-thesis
Electrical engineering / Computational engineering / Accelerator physics / Mathematics

TECHNISCHE UNIVERSITÄT DARMSTADT

1. Context

Introduced in the early 2010, the isogeometric analysis (IGA) is a numerical technique for discretizing partial differential equations. The major advantage of IGA over other alternatives, such as the conventional finite element method (FEM) for instance, lies in its ability to represent exactly complex geometries. Indeed, while classical methods are relying on polynomial approximations of the computational domain, IGA directly exploits the non-uniform rational B-splines (NURBS) representation used in computer-aided design (CAD) tools. This unique feature allows IGA to reach a tremendous level of accuracy. Nonetheless, when comparing the resulting matrices, the FEM leads usually to more advantageous non-zero patterns.

2. Task

This project aims at comparing the isogeometric analysis with the (high-order) finite element method. In particular, the performance of direct LU solvers on the resulting IGA and FEM matrices will be investigated. All developments will be made with already available IGA and FEM libraries (e.g. http://rafavzqz.github.io/geopdes/ and http://getdp.info).

3. Prerequisites

Interests in numerical methods and programing, basic knowledge of FEM helpful.

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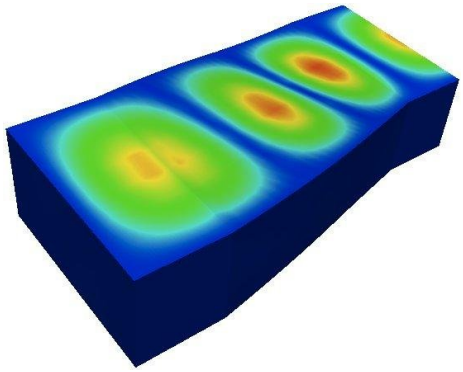

Fig. 1. electromagnetic wave in a distorted guide simulated by IGA (GeoPDEs)