Fast, Parametrized FEniCS Numerical Model of a TEM Cell

Bartosz Chaber, Jacek Starzyński, Zuzanna Krawczyk, Robert Szmurło
Warsaw University of Technology
bartosz.chaber@ee.pw.edu.pl, jstar@ee.pw.edu.pl, krawczyz@ee.pw.edu.pl,
robert.szmurlo@ee.pw.edu.pl

Abstract

This paper describes a fast numerical model of a TEM (Transversal Electromagnetic Mode) cell prepared with FEniCS toolset. The goal of this research is to build an accurate computer simulator, capable of assessing structure's performance. Such a simulator could be useful in design optimization process looking for the optimal parameter set.

Computer Aided Design draws heavily from detailed numerical simulations of devices and systems. Numerical models can help choosing optimal set of parameters for new device designs [1]. They can also help predicting device's performance [2, 3, 4]. Because such simulations are often run repeatedly, it is crucial for them to be fast. As noted in [4] commercial software packages can be convenient when setting up a new model. However, they seem to perform slower than some more specialized software packages.

A specialized software can be tailored to a particular problem, using its specific features to speed up computations. However, writing a Finite Element Method (FEM) simulator from scratch is a time-consuming and error-prone process. For these reason many researchers prefer to use commercial software. Nowadays the modern scientific frameworks for solving Partial Differential Equations can help to overcome the difficulties mentioned above. FEniCS provides an extensive set of numerical classes implemented in C++ and wrapped with Python classes. It allows to build a specialized simulator in a short time.

The presented model includes the TEM cell structure together with its input and output ports. Results from the model will be verified with a corresponding COMSOL model. Besides accuracy of the result, execution time and consumed resources will be compared.

References

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