Algorithm comparison for the determination of toroidal harmonics

TECHNISCHE UNIVERSITÄT DARMSTADT

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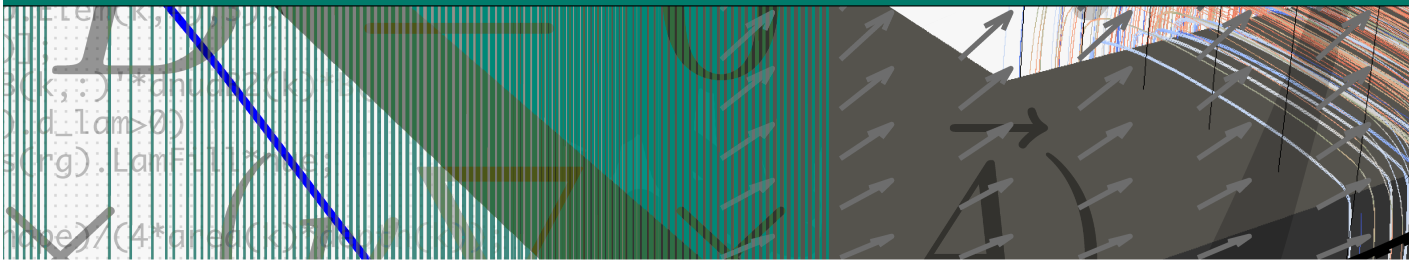

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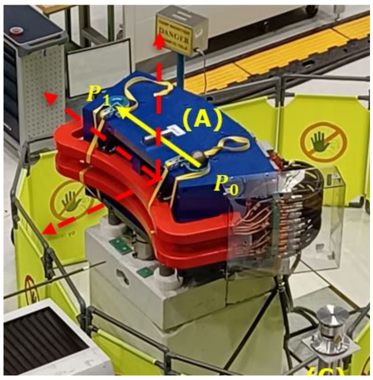

Figure 1: Normal conducting H-Magnet.

Description

The classical way of expressing the field uniformity in accelerator magnets is by means of the Fourier coefficients of the trigonometric eigenfunctions of the Laplace equation also known as multipoles. When the magnets are curved (Fig. 1), higher-order terms appear and the scaling laws derived for straight magnets are no more applicable. The field reconstruction from field simulations or magnetic measurements should therefore be based on the eigenfunctions of the Laplace equation in the toroidal coordinate system, so called toroidal harmonics.
TU Darmstadt, together with the European Organization for Nuclear Research (CERN) formulated a linear inverse problem to determine the toroidal harmonics from the magnetic flux density.
In this thesis, different algorithms to solve this inverse problem shall be studied and compared on magnetic flux density measurements of the magnet shown in Fig. 1.

The thesis will be supervised by Luisa Fleig, PhD student at CERN, and Prof. Dr. Sebastian Schöps in Darmstadt.

Work plan

- Brief study of the derivation of the inverse problem
- Study and comparison of different solving algorithms on given measurement data (Least squares, Kalman filter, Metropolis-Hastings algorithm)

Prerequisites

Basic knowledge in linear algebra, stochastic and MATLAB.

CEM