Development of a Stream Function Approach for Accelerator Magnet Design using the Bembel C++ Library

TECHNISCHE UNIVERSITÄT DARMSTADT

Proposal for a Bachelor Thesis
Study field: Computational Engineering | Electrical Engineering | Computer Science | Mathematics
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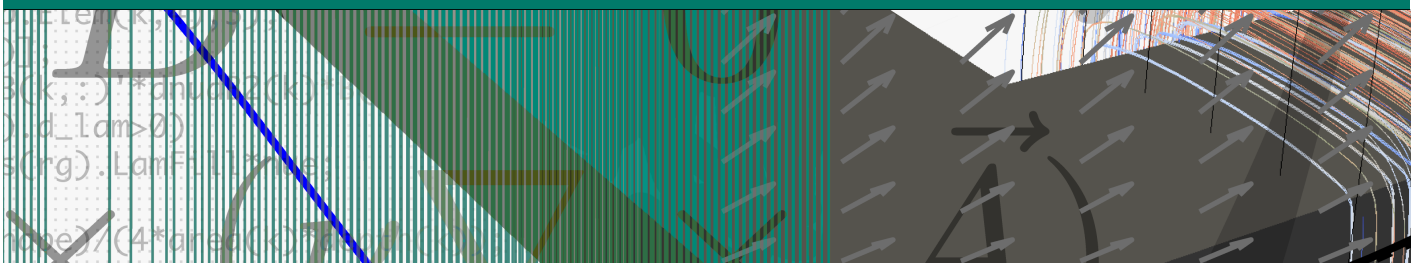

Description

The determination of optimal current distributions on given surfaces is often the starting point for the electromagnetic design of coil dominated electromagnets utilized, e.g. in particle accelerators and magnetic resonance imaging (MRI). Geometrical and mechanical constraints as well as the particle beam size determine the coil winding surface, on which an optimal current density is to be determined.
In this Bachelor thesis, a stream function approach for the determination of optimal current densities on given surfaces shall be developed and implemented in Bembel, the BEM-based engineering library, see `www.bembel.eu`. The goal is an automated generation of winding paths, on given surfaces and field quality requirements.

Work plan

- Study of Bembel and its software architecture, with the help of the libraries authors.
- Implementation of boundary conditions for equal stream function values at the open ends of the winding surface.
- Investigation of optimization algorithms and cost functions incorporating the total field energy, machining limitations and Laplace forces.
- The winding path determination based on the iso-lines of the stream function.

Prerequisites

A strong affinity to programming and experience with C/C++ (or the motivation to learn it on short term). Basic understanding of numerical schemes for the solution of partial differential equations.

Contact:
Dr.-Ing. Melvin Liebsch
Maximilian Nolte, M.Sc.
Prof. Dr. Sebastian Schöps
`maximilian.nolte@tu-darmstadt.de`

Figure 1: Bembel Logo