

Bachelorthesis / Masterthesis

Investigation of Line Search Strategies for Quasi-Newton Methods in Computational Electromagnetics

Motivation

When modeling nonlinear and hysteretic phenomena in computational electromagnetics, iterative solution strategies based on quasi-Newton methods are required, relying on line search strategies to ensure global convergence. In the in-house finite element method (FEM) package openCFS, several line search strategies are already implemented. However, strongly nonlinear behavior may still lead to convergence difficulties. Additionally, the termination criteria based on residual and increment norms are typically chosen heuristically. This thesis aims to investigate additional line search strategies proposed in the literature and conduct benchmark tests and convergence studies to determine appropriate termination criteria for the \vec{H} - and ϕ -formulations of Maxwell's equations.

Research Questions

Which line search strategies from the literature are suitable for nonlinear and hysteretic electromagnetic FEM problems, such as those used in solid mechanics? How do different methods compare in terms of robustness, convergence, and computational cost? Which termination criteria are physically meaningful and sufficiently problem-independent for the \vec{H} - and ϕ -formulations?

Tasks

- Literature review on line search strategies for quasi-Newton methods
- Selection and implementation of suitable methods in openCFS (programming language is C++)
- Conduct benchmark tests and convergence studies (e.g., using TEAM benchmark problems)

Organization

- Language: English
- Start: Immediately

Contact/Supervisor

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