

Bachelor Thesis (Bakkalaureatsarbeit)

on the topic

“Some Benchmark Problems in Electromagnetics”

- **Title:** Some Benchmark Problems in Electromagnetics
- **Supervisor:** DI Peter Gangl
- **Student:** Bernhard Oberndorfer
- **Abstract:** The interaction of electric and magnetic fields is described by Maxwell’s equations (James C. Maxwell, 1831-1879) in combination with material laws. Initial and boundary conditions complete the mathematical model. Under certain assumptions, the full Maxwell equations can be reduced to different regimes (magnetostatic regime, electrostatic regime etc.). In general, these mathematical models can not be solved analytically. Therefore, the electromagnetic simulation is based on numerical methods. However, there are some important special cases where the Maxwell equations can be solved analytically under appropriate assumptions. These special settings can serve as benchmarks for testing numerical simulation codes.

In the magnetostatic case, such benchmarks include

- Straight wire
- Circular conductor loop
- Coils: long solenoid, toroidal coil, Helmholtz coil

The analytic solution to these benchmark problems should be derived from Maxwell’s equations and further examples should be elaborated autonomously.

- **Road Map for the Bachelor Thesis:**
 1. Introduction
 2. Derivation of Maxwell’s equations
 3. Special regimes
 4. Benchmark problems
 5. Conclusion
 6. References
- **Literature:** Seminar (Proseminar) on Mathematical Models in Engineering
- **Additional Literature:** [1], [2], [3]

References

- [1] H. Henke. *Elektromagnetische Felder - Theorie und Anwendung*. Springer Berlin, Heidelberg, fourth edition, 2011.
- [2] M. Kaltenbacher. *Numerical Simulation of Mechatronic Sensors and Actuators*. Springer Berlin, Heidelberg, 2004.
- [3] J. P. A. Bastos N. Ida. *Electromagnetics and Calculation of Fields*. Springer New York, second edition, 1997.