Mohammadmahdi (Mahdy) Maharebi

M.Sc. Student – Electrical Communication Engineering

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Professional Summary

M.Sc. student specializing in **computational photonics and computational physics** with a strong foundation in **numerical methods** (FDTD, FEM, eigenmode solvers) and **reproducible scientific software**. Experienced in verification and validation of EM solvers, operator perturbation theory, and research-grade workflows. Silver medalist in Iran's National Physics Olympiad. Interested in reproducible computational photonics workflows and physics-based modeling of optical and material systems.

Selected Reproducible Projects

FDTD PEC cavity solver (code + report): github.com/mmaharebi/fdtd-pec-cavity
Reproducible: one-command rerun, figures regenerated from raw data, tests included.

Fiber mode perturbation analysis (code + report): github.com/mmaharebi/fiber-perturbation
Reproducible: one-command rerun, figures regenerated from raw data, tests included.

Education

M.Sc. Electrical Communication Engineering 2024–Present
University of Kassel, Germany
GPA: 1.53/1.0 (sehr gut)
Key courses: Microwaves (1.0), Optoelectronics (1.0), Engineering Mathematics (1.0), Digital Communications Lab (1.3), Digital Communications (1.7).
Focus areas: computational EM, photonics, optimization, signal processing.

B.Sc. Electrical Engineering 2017–2023
Sharif University of Technology, Iran
Focus on electromagnetics, microwave engineering, and signal processing.
Teaching Assistant: Circuit Analysis I (Head TA), Circuit Analysis II, Object-Oriented Programming in Java.

Research Experience

2D FDTD PEC Cavity Solver 2025
Python/NumPy – Computational Electromagnetics

- Developed TMz FDTD solver with CFL-stable update equations (tested up to 200×200 grid).
- Validated five cavity eigenmodes with 0.43% mean error.
- Implemented FFT-based mode extraction with probe averaging.
- Demonstrated convergence behavior: error scales as Δx^2 with mesh refinement.
- Produced convergence plots and animations in a reproducible workflow.

Fiber Mode Perturbation Analysis 2025
Python/SciPy – Operator Theory & Numerical Methods

- Derived first-order sensitivities of β and n_{eff} under fabrication variations.
- Implemented eigenmode solvers with $< 0.1\%$ numerical error (Brent root-finding with adaptive tolerance).
- Produced tolerance maps for realistic refractive-index and radius deviations.
- Verified perturbation theory validity: first-order predictions agree with full solutions within 2%.
- Developed manuscript-ready figures and reproducible analysis scripts.

Selected Engineering Projects

Antenna & RF Design Portfolio 2021–2023
HFSS / ADS / MATLAB

- Designed a 16 dBi horn antenna with optimized matching.
- Modeled a phased dipole array with mutual coupling analysis.
- Designed a 3 dB branch-line coupler with >20 dB isolation.

Adaptive FEM Visualization Tool 2023
C# / WPF

- Implemented a tool for FEM field visualization and mesh reconstruction.
- Integrated Delaunay triangulation and automated parsing routines.

Technical Skills

Computational EM: FDTD, FEM post-processing, eigenmode solvers, perturbation analysis, PDE discretization
Verification & Validation: Convergence analysis, error estimation, stability testing, benchmark validation
Programming: Python, MATLAB, C++, C#, TypeScript/React
Scientific Workflows: Linux/Bash, CI testing, reproducible pipelines, Git/GitHub, Jupyter
RF Tools: HFSS, ADS; S-parameters, array factor analysis
Domains: Computational photonics, EM simulation, antennas, microwaves, signal processing

Awards & Distinctions

Silver Medal – National Physics Olympiad 2017
Iran

National Elites Foundation Recognition 2017
Government of Iran

Languages

English: Professional
German: A2.1 (actively improving)
Persian: Native