

Author of the PathSim simulation ecosystem and of a vertically integrated simulation stack for electronics: electromagnetic field solvers, symbolic circuit analysis, and system-level simulation. One architecture throughout: SSA compute graphs at the core of the engines, Rust cores, Python APIs, browser interfaces.

EXPERIENCE

2025 - present

Independent engineering consultant · self-employed

- Custom solvers and engineering tools for client teams; commercial licensing of FastSim, SANE and RapidMoM
- Client work including in-browser C compilation and GPU dispatch of batched dynamical systems (under NDA)
- Open-source collaboration with the MIT Plasma Science and Fusion Center and the UK Atomic Energy Authority on tritium fuel-cycle modelling

2023 - 2025

Research associate · Institut für CMOS Design, TU Braunschweig

- Numerical modelling of electrochemical sensors for analog circuit design
- System design and hardware for bio-impedance spectroscopy
- EDA pipeline for RFIC passives, validated in silicon for cryogenic quantum applications

2021 - 2023

Research assistant · Institut für CMOS Design, TU Braunschweig

- High-frequency measurement calibration methods and verification hardware; taught the circuit theory seminar

2019 - 2020

Intern, electrics/electronics development · Volkswagen AG, Wolfsburg

- Low-voltage and redundant power supply systems: concept, schematic, hardware, ASIL considerations

2018 - 2021

Teaching assistant · TU Braunschweig

- Weekly independent tutorials on linear dynamical systems and circuit theory for 50+ students

EDUCATION

2023 - present

PhD candidate, electrical engineering (external) · TU Ilmenau

2021 - 2023

M.Sc. electrical engineering, with honors · TU Braunschweig

Thesis (graded excellent): area optimized neural network based modelling of passive magnetic structures for chip-level integration

2015 - 2021

B.Sc. electrical engineering · TU Braunschweig

Thesis (graded excellent): order reduction of interconnect network models for efficient calculation with SPICE simulators

OPEN SOURCE & PRODUCTS

PathSim

Python framework for hybrid system simulation. JOSS-published, 400+ GitHub stars, adopted by JSBSim, used at MIT PSFC and UKAEA for fusion fuel-cycle modelling.

FastSim

Drop-in Rust engine for PathSim: trace-based JIT, symbolic autodiff, FMI 3.0, C99 code generation. 191x median per-step speedup over the Python engine.

SANE

Symbolic and numeric circuit analysis in Rust with a native Verilog-A frontend; validated against ngspice and Xyce, scales past 100k parameters.

RSLAB	Sparse direct solver in pure Rust (LDLT, LU, KLU paths); benchmarked against MKL PARDISO and faer, bit-identical across thread counts.
RapidFEM / RapidMoM / RapidMesh / RapidPassives	Electromagnetic solver stack: Maxwell FEM, 2.5D MoM for planar RF passives, tetrahedral and planar meshing, browser-based RFIC layout generation.
PathView	Browser-based visual editor for PathSim models, running client-side through Pyodide. Started at MIT PSFC, now part of the PathSim organization.

PUBLICATIONS

M. Rother, "PathSim - A System Simulation Framework", Journal of Open Source Software 10(109), 8158, 2025.
R. Delaporte-Mathurin, R. MacDonald, J. Dark, M. Rother, T. Zulfiqar, K. B. Woller, "Physics-informed tritium fuel cycle modelling workflow for fusion reactors", arXiv:2603.25751, 2026.

TALKS

PathSim: Block Diagram Simulation in Pure Python. PyCon DE & PyData, April 2026.
An open-source Python framework for dynamic system simulation in fusion energy applications. OSSFE 2026, March 2026.
PathSim. IAEA Workshop on Digital Engineering for Fusion Energy Research, MIT Plasma Science and Fusion Center, December 2025.
PathSim. GAMM RSE/RDM workshop, December 2025.
The decentralized perspective on dynamical system simulation. Guest lecture, MUSEN colloquium, TU Braunschweig, May 2025.
PathSim. Gauss Fusion, May 2025; IFAS, May 2025.
Die Anatomie eines Systemsimulators. IMMS, March 2025.

SKILLS

Programming: Python, Rust, TypeScript, C, LaTeX

Numerics: FEM and MoM electromagnetics, circuit simulation (MNA, harmonic balance, Verilog-A), ODE/DAE solvers, sparse direct solvers, model order reduction, automatic differentiation, JIT compilation

Web & tooling: SvelteKit, WebGL, WebAssembly / Pyodide, PyO3, CI pipelines

BEYOND ENGINEERING

2014 - 2021 Competition climbing coach, DAV Braunschweig: led the team from entry level to international level.