

# Felix Koehler

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- My research focuses on machine learning (in particular deep learning) for physical simulations (like fluid and solid mechanics), adjoint methods and automatic differentiation, inverse problems as well as optimization algorithms
- My recent paper *APEBench* (a PDE surrogate benchmark suite in JAX) was accepted at NeurIPS 2024
- I own the largest YouTube channel ([@MachineLearningSimulation](https://www.youtube.com/@MachineLearningSimulation)) for in-depth tutorials in Scientific Machine Learning (>24k subs)

## EXPERIENCE

### PhD Student

Technical University of Munich, supervised by [Nils Thuerey](#)

September 2022 – Present (anticipated graduation: 12/26)

- Published at NeurIPS 2024: *APEBench: A Benchmark for Autoregressive Neural Emulators of PDEs* ([Arxiv](#), [Code](#), [Project Page](#))
- Under review at ICLR 2025: *Progressively Refined Differentiable Physics* ([OpenReview](#))
- Coordinated annual lecture in GamePhysics (applied numerical methods + simple mechanical modeling) for >200 students
- Supervised multiple students, e.g., [Unrolled vs. Implicit Autodiff for Linear System Solves](#) by Kanishk Bhatia
- Instructed a lecture on *Autodiff and Adjoints in Differentiable Physics* for our *Physics-Based DL* master course ([Recording](#), [Slides](#))

### Research Student

Siemens Corporate Technology, supervised by [Dirk Hartmann](#)

March 2020 – April 2022

- Researched explainable & efficient explicit approximations to model predictive control strategies with patent filed ([US20240176310](#))

### Research Intern

Volkswagen

October 2018 – March 2019

- Extended Volkswagen's topology optimization suite with adjoint-based sensitivity analysis, resulting in up to 40% additional weight reduction for the investigated casted steering knuckles; results presented at 13th WCSMO ([Paper](#))

### Additional Positions

- Research Engineer @ [TUM Hyperloop](#) in electromagnetic simulations with ANSYS Maxwell and Multidisciplinary Optimization, where I developed surrogate models for electromagnetic levitation/propulsion and coordinated access to LRZ supercomputing resources
- Multiple Teaching Assistant positions: [ODEs](#), [PDEs](#), [Vector Calculus](#), [Linear Algebra](#), [Thermodynamics](#)

## SKILLS

- Spoken languages: [English](#) (professional, IELTS 8.5/9.0), [German](#) (native), [French](#) & [Swedish](#) (elementary)
- [Python](#): [JAX](#), [Tensorflow 2](#), [PyTorch](#), [Matplotlib](#), [Pandas](#), [Seaborn](#), [Scikit-Learn](#), [SciPy](#), [NumPy](#), [FEniCs](#)
- [C++](#): [OpenMP](#), [MPI](#), [Eigen](#)
- Other programming languages: [Julia](#), [bash](#), [FORTRAN](#)
- Tools/Platforms: [Linux](#) (Ubuntu & Arch), [Git](#), [Docker](#), [OpenFoam](#), [Paraview](#), [ANSYS Maxwell](#), [Siemens Amesim](#)

## EDUCATION

### M.Sc. Computational Science & Engineering (CSE)

Technical University of Munich, **GPA: 1.2** (German system: 1.0 (best) to 6.0 (worst)), best 2%

October 2019 – April 2022

- Relevant course work: [Numerical Analysis](#) (2 semesters), [Parallel Programming](#), [High-Performance Computing](#), [Parallel Numerics](#), [Scientific Computing](#), [ML for Graphs & Sequential Data](#), [Uncertainty Quantification](#), [Machine Learning](#), [Probabilistic Machine Learning](#), [Visualization](#), [Nonlinear Finite Element Method](#), [Computational Plasticity](#)
- Honors: Scholarship by *Studienstiftung des Deutschen Volkes* (most prestigious national scholarship program in Germany)

### B.Sc. Mechanical Engineering

Technical University of Braunschweig, **GPA: 1.1** (German system: 1.0 (best) to 6.0 (worst))

October 2015 – January 2019

## PROJECTS & OPEN SOURCE

- Machine Learning & Simulation YouTube channel: I created more than 200 videos on AI for Science and adjacent topics ([autodiff](#), [optimization](#), [probability](#), [neural networks](#) etc.). Examples: [FNO](#), [DeepONet](#), [Adjoint ODEs](#), [Variational Inference](#)
- [Exponax](#): I designed and maintain a JAX-based Fourier-spectral PDE solvers library based on ETDRK methods ([Docs](#))
- [PDEquinox](#): I designed and maintain a JAX/Equinox-based library for PDE neural operators like [ConvNets](#), [ResNets](#), [MLPs](#), [UNets](#), [Dilated ResNets](#) ([Docs](#))
- Course on Scientific Computing in Python: I devised and taught a graduate-level course three times to 25 students each ([Resources](#), [Recording Day 1](#), [Recording Day 2](#), [Recording Day 3](#))
- I translated a Shallow Water Equations solver to Julia ([Tsunamis.jl](#) GitHub Repository, [Report paper](#))
- I implemented Stable Fluids (for solving the Navier-Stokes Equations) in Julia ([StableFluids.jl](#) GitHub Repository)