Erick Schulz

Computational science engineer with a PhD in mathematics interested in research,
technical software development and new technologies, with experience in numerical
methods, algorithms for simulation, scientific product development and leadership

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Industry Experience

Plexim GmbH, Zurich, Switzerland

Head of Scientific Software Development   2024 - ongoing
Team Lead Research Scientist   2023 - 2024
Scientific Software Developer   2022 - 2023

- *Core Technology:* R&D in high-performance differential algebraic equations (DAEs) solvers for the simulation of multi-physics, mixed-formulations, mixed-signals circuits and power electronics systems
  Keywords: sparse & dense linear algebra, KLU, QR and SVD decomposition, multi-threading, automatic differentiation, ExprTk, Netlist parsing, graph algorithms, Runge–Kutta time-stepping, BDFs, interpolation, error estimation, nonlinear optimization, voltage limiting

- *Product Development:* Building a state-of-the-art SPICE solver with innovative technology (multiyear roadmap); created a native fuzzy-search command-launcher/model-finder tool to improve UI/UX and discoverability of features in our flagship software PLECS; deployed a Python package (`thermal-network`) using JAX and Optax for surrogate thermal modeling of semiconductor devices (gradient-based fitting, model identification)

- *Real-Time Systems:* Development and stability analysis of new numerical schemes for real-time simulation on FP-GAs (RT box)

- *Leadership:* Lead a team of 6 research scientists and engineers (PhDs and Masters); code reviews; supervised Bachelor and Master's theses in collaboration with ETH Zurich; traveled internationally to give workshops to research institutes, engineering firms and manufacturers of semiconductors

- *Tooling & Tech Stack:* C++ with Qt, embedded Lua, CMake, Gitlab, Git (version control), testing pipeline, Python, MATLAB, Octave (for initialization scripts), Modelica, circuit schematic editors

Mitsubishi Electric Research Laboratories (MERL), Cambridge, USA

Research Intern   May 2017 - Aug 2017

- *Modeling & Optimization:* Simulation and optimization of large-scale HVAC systems with surrogate models; built a Levenberg-Marquardt optimizer (least-squares) with geodesic acceleration (using SUNDIALS for transients) to fit physically-based models to temperature data (MATLAB); simulated DAEs arising from a robot arm model

- *Tooling & Tech Stack:* MATLAB, Modelica, Mercurial (version control)

Montreal University Hospital Center (CHUM), Montreal, Canada

Research Assistant, Department of Neurosurgery   May 2012 - Aug 2012

- Conducted literature review on motor learning (brain processes involved in imitation games)

MEEIR, Montreal, Canada

Laboratory Technician, Research Institute on Electricity of Quebec (IREQ)   part-time, 2010-2011

- Processed and graded ruthenium powder by particle size through multi-stage sieving.

Academic Experience

ETH Zurich, Zurich, Switzerland

Scientific Assistant, Seminar for Applied Mathematics (SAM)   2018 - 2022

- Research at the interface of numerical analysis and differential geometry (PDEs on manifolds), leading to multiple publications in top-tier journals and presentations at international conferences
  Keywords: manifolds, electromagnetism, scattering, domain decomposition, boundary and finite element methods (FEM & BEM), exterior calculus, clifford algebras, resonant frequencies, Hilbert complexes, conservative methods

McGill University, Montreal, Canada
Research Assistant, Department of Mathematics and Statistics   2014 - 2016

- *Scientific Computing:* Developed a Lattice Gauge Theory solver in C for the Yang-Mills equation, implement gradient descent and line search on Principal Fiber bundles

- *Algorithm Implementation:* Implemented an algorithm in C to study Copulas and measures of statistical correlation

Education

ETH Zurich, Zurich, Switzerland
Doctorate (PhD) – Applied Mathematics   2018 - 2022

- **Director:** Prof. Ralf Hiptmair

- **Thesis:** Developed a novel theory of boundary integral equations for the (possibly perturbed) Hodge-Dirac and Hodge-Laplace operators, advancing our understanding of low frequency models in electromagnetism and the structure of first-kind integral equations on manifolds

Polish Academy of Science, Warsaw, Poland
Advance Course – Finite Element Method   July 2019

- Advanced course on the Finite Element Method (FEM) from the European Community on Computational Methods in Applied Sciences (ECCOMAS) organized by the Polish Association for Computational Mechanics

McGill University, Montreal, Canada
Master's (M.Sc.) – Applied Mathematics   2016 - 2018

- **Director:** Prof. Tsogtgerel Gantumur

- **Thesis:** Published the first proof of convergence of Discrete Exterior Calculus (DEC) for the N-dimensional Poisson problem (a method used in digital geometry processing and computer graphics)

Bachelor (B.A.) – Honours Mathematics & Computer Science   2012 - 2016

- Graduated with First Class Honours

- Dean's Honour List (Top 10% of Faculty)

- **Highlights:** numerical methods, differential geometry, analysis & algebra, ODEs & PDEs, algorithms & data structures

Teaching

ETH Zurich, Zurich, Switzerland
Organizer & T.A.   2018 - 2022

- Contributed in developing the curriculum, exercises and exams for *Numerical Methods for PDEs*; mentored and supervised teaching assistants; led weekly exercise sessions and prepared examinations for large classes

- Weekly exercise sessions for *Numerical Methods for Application in Engineering II*

F.A.C.E., Montreal, Canada
Teacher Assistant   part-time, 2013 - 2015

- Led biweekly exercise sessions for elementary and high school students, focusing on mathematics and science.

Activities & Leadership

NPDECODES Project   2018 - 2022
Project Co-Lead

- Led a team of student developers in creating **NPDECODES**, a C++ repository of ~ 65 physical simulation and optimisation algorithms, now the standard framework for the course.
  Keywords: wave propagation, convection-diffusion, conservation laws, electrostatics, force calculations, error estimators, convergence analysis, polynomial fitting, method of lines and much more; C++, Python

Seminars in Undergraduate Mathematics in Montreal (SUMM)

VP Finance   2015 - 2016

Organizing Committee Member   2014 - 2015

SUMM is an annual conference organized in collaboration by students of all four universities in Montreal, QC, Canada. Of provincial scale, it is the largest event of the type in Quebec. It benefits to undergraduate students from universities of both Quebec and Ontario.

McGill CodeJam - Artificial Intelligence   2014

Hackathon (48h)

- Design and implementation of a facial recognition algorithm based on PCA

Skills

Programming	**C++:** Modern C++, STL, Eigen
	Familiarity: CMake, Qt, CUDA
	Python: NumPy, SciPy, Matplotlib
	Familiarity: Pandas, JAX, Optax
	Other: MATLAB, Modelica, LaTeX, Git, GitLab & GitHub
	Familiarity: Lua, Octave
Core Competencies	Numerical Methods for ODEs, DAEs & PDEs
	Applied Mathematics
	Scientific Computing
	Research & Development
	Leadership & Project Management

Awards

Nominated for ETH Medal	2022
Graduate Excellence Fellowship Award	2017
Undergraduate Student Research Award (NSERC)	2015
Collegiate Literature Award	2011

Publications

- Multiple international conference presentations in Canada, Germany, Switzerland and UK

[1]   Erick Schulz and Ralf Hiptmair. "First-kind boundary integral equations for the Dirac operator in 3-dimensional Lipschitz domains". In: *SIAM Journal on Mathematical Analysis* 54.1 (2022), pp. 616–648.

[2]   Erick Schulz and Ralf Hiptmair. "Spurious resonances in coupled domain-boundary variational formulations of transmission problems in electromagnetism and acoustics". In: *Computational Methods in Applied Mathematics* 22.4 (2022), pp. 971–985.

[3]   Erick Schulz and Ralf Hiptmair. "Coupled domain-boundary variational formulations for Hodge–Helmholtz operators". In: *Integral Equations and Operator Theory* 94.1 (2022), p. 7.

[4]   Matthias Kirchhart and Erick Schulz. "Div–curl problems and H1-regular stream functions in 3D Lipschitz domains". In: *Mathematical Methods in the Applied Sciences* 45.3 (2022), pp. 1097–1117.

[5]   Erick Schulz and Gantumur Tsogtgerel. "Convergence of discrete exterior calculus approximations for Poisson problems". In: *Discrete & Computational Geometry* 63 (2020), pp. 346–376.

[6]   Ralf Hiptmair, Dirk Pauly, and Erick Schulz. "Traces for Hilbert complexes". In: *Journal of Functional Analysis* 284.10 (2023), p. 109905. ISSN: 0022-1236.

[7]   Erick Schulz, Ralf Hiptmair, and Stefan Kurz. "Boundary integral exterior calculus". In: *Journal of the European Mathematical Society* (2025).

[8]   Ralf Hiptmair and Erick Schulz. "Boundary element exterior calculus". In: *TBD* (in progress).

[9]   Erick Schulz and Andy T. S. Wan. "Minimal ℓ^2 norm discrete multiplier method". In: *Journal of Computational Dynamics* 12.2 (2025), pp. 212–238. ISSN: 2158-2491.