Leon **Sering**

SENIOR ALGORITHM ENGINEER AT MOIA

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Summary

I am a mathematician and computer scientist developing routing algorithms for MOIA. In addition to my theoretical research on Nash flows over time (agent-based traffic modeling), I have a strong passion for fast optimization algorithms.

My programming language of choice? Rust. This high-performance systems programming language, with its focus on fearless concurrency, is the perfect tool for my projects. And most importantly: it's fun to use!

In my downtime, you'll find me with my family, exploring the wonders of the world through road trips, photography, and scuba diving.

For more details, visit my homepage: **https://leon.sering.eu**.

Work Experience

Senior Algorithm Engineer
Berlin, Germany

MOIA, ROUTING TEAM
August 2024 - today

- Developing routing algorithms in a AWS cloud environment using Rust
- Customizable contraction hierarchies, via-routing, route matching

Operations Research Expert (Freelancer)
Paderborn, Germany

OPTANO GMBH
May 2023 - June 2023

- Consulting services for a line haul solution.
- Design of mixed-integer linear program.
- Implementation of a fast multi-objective routing algorithm.

Postdoctoral Researcher
Zurich, Switzerland

INSTITUTE FOR OPERATIONS RESEARCH, DEPARTMENT OF MATHEMATICS, ETH ZÜRICH
April 2021 - July 2024

- Leading scientific collaboration with Swiss Post and Swiss Federal Railways SBB.
- Design and implementation of fast clustering algorithm.
- Research in operations research, efficient algorithms, meta-heuristics, and parallelism.

Research Associate
Berlin, Germany

RESEARCH GROUP: COMBINATORIAL OPTIMIZATION & GRAPH ALGORITHMS, INSTITUTE OF MATHEMATICS, TU BERLIN
May 2017 - March 2021

- ECMath and MATH+ research projects: dynamic models and algorithms for equilibria in traffic networks.
- Research goals: improve agent-based mathematical flow over time models (Nash flow over time) to connect with large-scale traffic simulations such as MATSim.

Education

Dr. rer. Nat. in Mathematics
TU Berlin, Germany

DISSERTATION TITLE: NASH FLOWS OVER TIME, GRADE: SUMMA CUM LAUDE, MATH+ DISSERTATION AWARD
Sep. 2016 - Sep. 2020

- PhD topic: traffic simulation and optimization by using flows over time including game theoretical aspects.

Master of Advanced Studies
University of Cambridge, UK

PART III OF THE MATHEMATICAL TRIPOS, GRADE: WITH HONOURS
Oct. 2013 - Jul. 2014

Bachelor and Master of Science in Mathematics
University of Würzburg, Germany

GRADES: 1.0 / 1.0, AWARDS: 2x OTTO-VOLK-MEDAL FOR EXCELLENT PERFORMANCES
Oct. 2010 - Sep. 2014

Bachelor of Science in Computer Science
University of Würzburg, Germany

GRADE: 1.0, AWARD FOR EXCELLENT PERFORMANCES
Oct. 2010 - Apr. 2013

Selected Projects

Rolling Stock Scheduling Optimization
ETH - SBB - Collaboration

LANGUAGES AND TOOLS: RUST | DOCKER | HTTP SERVER
- Scheduling trains (rolling stock) for a given time tabel to minimize dead head trips.
- Approach: local-search heuristic using concurrency and min-cost flow optimization.

Fast Same-Day Delivery Optimization
ETH - Swiss Post - Collaboration

LANGUAGES AND TOOLS: SCALA | GUROBI | DOCKER | HTTP SERVER
- Vehicle Routing: Scheduling capacitated drivers to deliver shipments within time windows.
- Approaches: mixed integer program, local search heuristic, fast k-opt for TSP-subproblem.

Fair and Fast k-Center
Research Project at ETH Zürich

LANGUAGES: RUST | PYTHON
- Linear-time algorithm for k-center with fairness criteria that runs very fast in practice.
- Highly optimized for parallelism/concurrency.
- ICML publication.

Nash Flow Computation
Research Project at TU Berlin

LANGUAGES AND TOOLS: PYTHON | QT | SCIP
- Tool for computing Nash flows over time with mixed integer programming.

Drawing Road Networks with Focus Regions
Research Project

LANGUAGES AND TOOLS: JAVA | QT | CPLEX
- Tool for computing road network visualization with enlarged user-defined focus regions.
- TVCG publication.

Computer Skills

Computer Science
COMBINATORIAL OPTIMIZATION | META-HEURISTICS | FAST PARALLEL ALGORITHMS | MATHEMATICAL PROGRAMMING | TRAFFIC / LOGISTIC OPTIMIZATION

Programming Languages
RUST | SCALA | PYTHON | JAVA

Optimization Tools
GUROBI | SCIP

Miscellaneous
GIT | GITLAB | GITHUB | BASH | NEOVIM | DOCKER | CI/CD | LaTeX | LINUX | WINDOWS | OFFICE SOFTWARE

Scholarships and Competitions

Deutschlandstipendium
University of Würzburg

NATIONAL SCHOLARSHIP
May 2011 - Sep. 2015

Vereinigte Stipendien- und Preisstiftung
University of Würzburg

SCHOLARSHIP OF THE UNIVERSITY OF WÜRZBURG
Aug. 2010 - Apr. 2011

Award Winner in the Final Round of *26. Bundeswettbewerb Informatik*
High School

NATIONAL COMPETITION IN COMPUTER SCIENCE
Dec. 2007 - Sep. 2008

Languages

Fluent	**English**
Native	**German**

Interests

traveling | photography | scuba diving | running | computer games | virtual reality

[1] Christoph Hertrich and Leon Sering. "ReLU Neural Networks of Polynomial Size for Exact Maximum Flow Computation". In: *Mathematical Programming* (2024). A preliminary version was presented at the International Conference on Integer Programming and Combinatorial Optimization (IPCO '23), pp. 1–30. arXiv: 2102.06635.

[2] Neil Olver, Leon Sering, and Laura Vargas Koch. "Convergence of Approximate and Packet Routing Equilibria to Nash Flows Over Time". In: *Annual Symposium on Foundations of Computer Science (FOCS'23)*. IEEE. 2023. arXiv: 2402.04935.

[3] Theresa Ziemke, Leon Sering, and Kai Nagel. "Spillback changes the long-term behavior of dynamic equilibria in fluid queuing networks". In: *Workshop on Algorithmic Approaches for Transportation Modelling, Optimization, and Systems (ATMOS'23)*. OpenAccess Series in Informatics (OASIcs). Dagstuhl, Germany, 2023.

[4] Antonia Adamik and Leon Sering. "Atomic Splittable Flow Over Time Games". In: *Symposium on Algorithmic Foundations of Dynamic Networks (SAND'22)*. 2022, p. 53. arXiv: 2010.02148.

[5] Haris Angelidakis, Adam Kurpisz, Leon Sering, and Rico Zenklusen. "Fair and Fast k-Center Clustering for Data Summarization". In: *International Conference on Machine Learning (ICML'22)*. PMLR. 2022, pp. 669–702.

[6] Neil Olver, Leon Sering, and Laura Vargas Koch. "Continuity, Uniqueness and Long-Term Behavior of Nash Flows Over Time". In: *Annual Symposium on Foundations of Computer Science (FOCS'21)*. IEEE. 2022, pp. 851–860. arXiv: 2111.06877.

[7] Leon Sering, Laura Vargas Koch, and Theresa Ziemke. "Convergence of a Packet Routing Model to Flows over Time". In: *Mathematics of Operations Research (MOR)* 0.0 (2022). A preliminary version was presented at the 22nd ACM Conference on Economics and Computation (EC'21). arXiv: 2105.13202.

[8] Stefan Felsner, Linda Kleist, Torsten Mütze, and Leon Sering. "Rainbow Cycles in Flip Graphs". In: *SIAM Journal on Discrete Mathematics* 34.1 (2020). A preliminary version was presented at the International Symposium on Computational Geometry (SoCG'18), pp. 1–39. arXiv: 1712.07421.

[9] Lukas Graf, Tobias Harks, and Leon Sering. "Dynamic Flows with Adaptive Route Choice". In: *Mathematical Programming* 183.1 (2020), pp. 309–335. arXiv: 1811.07381.

[10] Jonas Israel and Leon Sering. "The Impact of Spillback on the Price of Anarchy for Flows over Time". In: *International Symposium on Algorithmic Game Theory (SAGT'20)*. Springer. 2020, pp. 114–129. arXiv: 2007.04218.

[11] Hoang Minh Pham and Leon Sering. "Dynamic Equilibria in Time-Varying Networks". In: *International Symposium on Algorithmic Game Theory (SAGT'20)*. Springer. 2020, pp. 130–145. arXiv: 2007.01525.

[12] Leon Sering. "Nash Flows Over Time". PhD thesis. Technische Universität Berlin, 2020.

[13] Theresa Ziemke, Leon Sering, Laura Vargas Koch, Max Zimmer, Kai Nagel, and Martin Skutella. "Flows Over Time as Continuous Limits of Packet-Based Network Simulations". In: *Transportation Research Procedia* (2020). A preliminary version was presented at The Euro Working Group on Transportation (EWGT'20).

[14] Leon Sering and Laura Vargas Koch. "Nash Flows Over Time with Spillback". In: *ACM-SIAM Symposium on Discrete Algorithms (SODA'19)*. 2019, pp. 935–945. arXiv: 1807.05862.

[15] Leon Sering and Martin Skutella. "Multi-Source Multi-Sink Nash Flows over Time". In: *Workshop on Algorithmic Approaches for Transportation Modelling, Optimization, and Systems (ATMOS'18)*. Vol. 65. OpenAccess Series in Informatics (OASIcs). Dagstuhl, Germany, 2018, 12:1–12:20. arXiv: 1807.01098.

[16] Leon Sering. "A Combinatorial Upper Bound on the Length of Twang Cascades". In: *European Workshop on Computational Geometry (EuroCG'17)*. Malmö, 2017, pp. 177–180.

[17] Jan-Henrik Haunert and Leon Sering. "Drawing Road Networks with Focus Regions". In: *IEEE Transactions on Visualization and Computer Graphics* 17.12 (2011). A preliminary version was presented at IEEE Information Visualization Conference (INFOVIS'11), pp. 2555–2562.