

# Dr. Matthias Rost

RESEARCHER · OPTIMIZATION EXPERT · SOFTWARE ENGINEER

Brüderstraße 21, 13595 Berlin, Germany

🏠 matthias-rost.de 📧 MatthiasRost 📺 matthias-rost



## Qualifications Summary

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My passion is optimization. Being an avid software engineer and an award-winning researcher with a deep mathematical background, my main expertise lies in solving challenging real-world optimization problems:

- 5+ years of cloud optimization research experience with 20+ peer-reviewed publications
- 10+ years of software development experience (Python, Java, C/C++, PL/SQL)
- Proven track record as algorithm engineer in 10+ projects (heuristics, approximations, exact algorithms)
- Mathematical optimization expert for (integer) linear programming and its applications (Gurobi, SCIP, CPLEX)
- Hands-on data science and visualization experience (NumPy, Matplotlib, Matlab, R)

## Professional Experience

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**Cloud Optimization Developer** SAP SE 01/2020 - present

Being part of a new innovations team within SAP's Global Cloud Services my task is to architect scalable cloud optimization algorithms to reduce the total cost of ownership and improve resiliency for SAP's various cloud offerings.

**Postdoctoral Researcher** TECHNISCHE UNIVERSITÄT BERLIN (FG IMA) 04/2019 - 01/2020

As postdoc in the Internet Measurement and Analysis group led by Georgios Smaragdakis, my focus lies on optimizing wide-area analytics by devising online strategies for replicating data to minimize overall traffic.

**Optimization Consultant** CYCLEVER GMBH 03/2018 - 06/2018

To validate the business model of delivering parcels using freight bicycles, I analyzed the potential gains of piggy-backing several parcels and derived insights into cost reductions when exchanging parcels on the fly.

**Research and Teaching Assistant** TECHNISCHE UNIVERSITÄT BERLIN (FG INET) 01/2014 - 03/2019

Within the Internet Network Architectures group, led by Anja Feldmann until March 2018 and by Thomas Zinner afterwards, I mainly worked with Stefan Schmid on novel resource orchestration algorithms in cloud networks:

- Successful completion of 10+ research projects on various cloud resource allocation problems, for example, virtual network embeddings, scheduling network updates, middlebox placement, and pathlet stitching
- TUB's algorithmic lead in FP7 EU project Unify on ISP clouds (including, i.a., Ericsson, Intel, Deutsche Telekom)
- Solving decade-long research challenge by developing first approximations for embedding virtual networks
- Awarded Software Campus grant by the German Federal Ministry of Education and Research to lead a team of student workers to assess practical applicability of novel approximations in a *large-scale algorithmic framework* 📄
- Coordination of undergraduate lectures with up to 1000 students, 5 research assistants and 35 tutors and the design and implementation of a *tailored optimization suite* 📄 for efficiently assigning and scheduling tasks

**Student Research Assistant** TECHNISCHE UNIVERSITÄT BERLIN (FG INET) 11/2011 - 12/2013

Funded by the Telekom Innovation Laboratories and supervised by Anja Feldmann and Stefan Schmid, I worked on the design and analysis of algorithms for multicast and aggregation trees and the scheduling of network embeddings

**Student Tutor / Teaching Assignments** FREIE UNIVERSITÄT BERLIN 04/2009 - 09/2010

I taught tutorials, created and corrected exercises and exams for undergraduate lectures on Computer Architecture (2009, 2010, 2011), Operating Systems and Computer Networks (2009), and Non-sequential Programming (2010).

**Student Software Developer** IVU TRAFFIC TECHNOLOGIES AG, BERLIN 08/2007 - 02/2009

I worked on IVU.fleet.data, a C/C++ tool using Oracle to manage the core data of public transport companies and implemented extensions for customers and optimized PL/SQL queries.

## Education

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<b>Ph.D. in Computer Science (Dr. rer. nat.)</b>	TECHNISCHE UNIVERSITÄT BERLIN	01/2014 - 03/2019
Thesis:	Virtual Network Embeddings: Theoretical Foundations and Provably Good Algorithms <a href="#">↗</a>	
Committee:	Rolf Niedermeier · Thomas Zinner · Stefan Schmid · Anja Feldmann · Harald Räcke	
Defense:	March 25, 2019	
Grade:	SUMMA CUM LAUDE (WITH DISTINCTION)	
<b>Master of Science in Computer Science</b>	TECHNISCHE UNIVERSITÄT BERLIN	04/2011 - 01/2014
Thesis:	Optimal Virtualized In-Network Processing with Applications to Aggregation and Multicast <a href="#">↗</a>	
Advisors:	Anja Feldmann · Andreas Bley · Stefan Schmid	
Final mark:	1.3 (VERY GOOD)	
<b>Study of Mathematics (undergraduate level)</b>	FREIE UNIVERSITÄT BERLIN	10/2010 - 09/2013
<b>Study of Computer Science (graduate level)</b>	FREIE UNIVERSITÄT BERLIN	10/2009 - 09/2010
<b>Bachelor of Science in Computer Science</b>	FREIE UNIVERSITÄT BERLIN	10/2006 - 09/2009
Thesis:	Modeling and Solving Evacuation Problems using Network Flows (translated)	
Advisors:	Günther Rote · Martin Skutella	
Final mark:	1.2 (VERY GOOD)	

## Awards and Grants

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<b>Best Paper Award</b>	IFIP NETWORKING CONFERENCE 2018	05/2018
<b>Hackathon Winner</b>	GTM <sup>3</sup> HACKATHON @ OPERATIONS RESEARCH 2017	09/2017
<b>Software Campus Grant</b>	GERMAN FEDERAL MINISTRY OF EDUCATION AND RESEARCH	03/2016
<b>Best Master Thesis Prize</b>	COMMUNICATION AND DISTRIBUTED SYSTEMS GROUP (KUVS)	03/2015
<b>Scholarship</b>	GERMAN ACADEMIC SCHOLARSHIP FOUNDATION	10/2009 - 3/2013

## Software Campus Management Trainings

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<b>Conflicts in Leadership Positions</b>	DEUTSCHE POST AG	11/2016
<b>Moderation for Professionals: Mastering Complex and Tough Situations</b>	DATEV EG	11/2016
<b>New as Executive - Basics for Tomorrow's Executive</b>	HOLTZBRINCK PUBLISHING	09/2016
<b>Projectmanagement Basics using the PMI-Standard</b>	SCHEER HOLDING	04/2016
<b>Intercultural Awareness</b>	SAP SE	04/2016
<b>Business meets Technology: Business Understanding for Engineers and Non-Economists</b>	SIEMENS AG	03/2016

## Extracurricular Activities

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<b>Amnesty International Deutschland e.V.</b>	10/2007 - present
I was particularly active from 2007 to 2011 and mainly volunteered at Freie Universität Berlin's group and was the group's spokesperson, led the organization of lecture series and of the first Jugend@Amnesty event in Germany.	
<b>German Academic Scholarship Foundation</b>	10/2009 - 03/2013
I participated in excursions and a two-week course on field-programmable integrated circuits (FPGAs).	

## Peer-Reviewed Publications

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### JOURNAL ARTICLES

#### On the Hardness and Inapproximability of Virtual Network Embeddings

Matthias Rost, Stefan Schmid

*IEEE/ACM Transactions on Networking (TON)*. 2020

#### Parametrized Complexity of Virtual Network Embeddings: Dynamic & Linear Programming Approximations

Matthias Rost, Elias Döhne, Stefan Schmid

*ACM SIGCOMM Computer Communication Review (CCR)*. 2019

#### Virtual Network Embedding Approximations: Leveraging Randomized Rounding

Matthias Rost, Stefan Schmid

*IEEE/ACM Transactions on Networking (TON)*. 2019

#### Transiently Policy-Compliant Network Updates

Arne Ludwig, Szymon Dudycz, Matthias Rost, Stefan Schmid

*IEEE/ACM Transactions on Networking (TON)*. 2018

#### Approximate and incremental network function placement

Tamás Lukovszki, Matthias Rost, Stefan Schmid

*Journal of Parallel and Distributed Computing (JPDC)*. 2018

#### It's a Match!: Near-Optimal and Incremental Middlebox Deployment

Tamás Lukovszki, Matthias Rost, Stefan Schmid

*ACM SIGCOMM Computer Communication Review (CCR)*. 2016

#### Beyond the Stars: Revisiting Virtual Cluster Embeddings

Matthias Rost, Carlo Fuerst, Stefan Schmid

*ACM SIGCOMM Computer Communication Review (CCR)*. 2015

#### Network Service Chaining with Optimized Network Function Embedding supporting Service Decompositions

Sahel Sahhaf, Wouter Tavernier, Matthias Rost, Stefan Schmid, Didier Colle, Mario Pickavet, Piet Demeester

*Computer Networks*. 2015

### CONFERENCE PROCEEDINGS

#### A Constant Approximation for Maximum Throughput Multicommodity Routing And Its Application to Delay-Tolerant Network Scheduling

Mengxue Liu, Andrea Richa, Matthias Rost, Stefan Schmid

*IEEE Conference on Computer Communications (INFOCOM)*. 2019

#### Modeling Adaptive Video Streaming Using Discrete-Time Analysis

Susanna Schwarzmann, Paula Breitbach, Thomas Zinner, Matthias Rost

*International Teletraffic Congress (ITC)*. 2019

#### Charting the Complexity Landscape of Virtual Network Embeddings

Matthias Rost, Stefan Schmid

*IFIP Networking*. 2018

#### Virtual Network Embedding Approximations: Leveraging Randomized Rounding

Matthias Rost, Stefan Schmid

*IFIP Networking*. 2018

#### An Approximation Algorithm for Path Computation and Function Placement in SDNs

Guy Even, Matthias Rost, Stefan Schmid

*Structural Information and Communication Complexity (SIROCCO)*. 2016

#### Stitching Inter-Domain Paths over IXPs

Vasileios Kotronis, Rowan Klöti, Matthias Rost, Panagiotis Georgopoulos, Bernhard Ager, Stefan Schmid, Xenofontas Dimitropoulos

*ACM Symposium on SDN Research (SOSR)*. 2016

#### Transiently Secure Network Updates

Arne Ludwig, Szymon Dudycz, Matthias Rost, Stefan Schmid

*ACM SIGMETRICS International Conference on Measurement and Modeling of Computer Systems*. 2016

#### It's About Time: On Optimal Virtual Network Embeddings under Temporal Flexibilities

Matthias Rost, Stefan Schmid, Anja Feldmann

*IEEE International Parallel and Distributed Processing Symposium (IPDPS)*. 2014

#### VirtuCast: Multicast and Aggregation with In-Network Processing

Matthias Rost, Stefan Schmid

*Principles of Distributed Systems (OPODIS)*. 2013

## WORKSHOPS & POSTERS

### Fast and Efficient Network Service Embedding Method with Adaptive Offloading to the Edge

Balázs Németh, Mark Szalay, Janos Doka, Matthias Rost, Stefan Schmid, Laszlo Toka, Balázs Sonkoly

*IEEE INFOCOM Workshop on Int. Edge Computing, Caching, and Offloading in Next Generation Networks. 2018*

### Efficient service graph embedding: A practical approach

Balázs Németh, Balázs Sonkoly, Matthias Rost, Stefan Schmid

*IEEE Conference on Network Function Virtualization and Software Defined Networks (NFV-SDN). 2016*

### Investigating the Potential of the Inter-IXP Multigraph for the Provisioning of Guaranteed End-to-End Services

Vasileios Kotronis, Rowan Klöti, Matthias Rost, Panagiotis Georgopoulos, Bernhard Ager, Stefan Schmid, Xenofontas Dimitropoulos

*ACM SIGMETRICS International Conference on Measurement and Modeling of Computer Systems. 2015*

### Good Network Updates for Bad Packets: Waypoint Enforcement Beyond Destination-Based Routing Policies

Arne Ludwig, Matthias Rost, Damien Foucard, Stefan Schmid

*ACM Workshop on Hot Topics in Networks (HotNets). 2014*

### Towards Unified Programmability of Cloud and Carrier Infrastructure

P. Sköldström, B. Sonkoly, A. Gulyás, F. Németh, M. Kind, F. J. Westphal, W. John, J. Garay, E. Jacob, D. Jocha, J. Elek, R. Szabó, W. Tavernier, G. Agapiou, A. Manzalini, M. Rost, N. Sarrar, S. Schmid

*European Workshop on Software Defined Networks (EWSDN). 2014*

## Presentations at Conferences

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### Approximating the Virtual Network Embedding Problem: Theory and Practice

*International Symposium on Mathematical Programming (ISMP), Bordeaux, France*

07/2018

### Approximate Graph Embeddings in the Cloud

*Highlights of Algorithms (HALG), Amsterdam, Netherlands*

06/2018

### Virtual Network Embedding Approximations: Leveraging Randomized Rounding

*IFIP Networking, Zurich, Switzerland*

05/2018

### Charting the Complexity Landscape of Virtual Network Embeddings

*IFIP Networking, Zurich, Switzerland*

05/2018

### An Approximation Algorithm for Path Computation and Function Placement in SDNs

*Int. Colloquium on Structural Information and Communication Complexity, Helsinki, Finland*

07/2016

### Transiently Secure Network Updates

*ACM SIGMETRICS, Antibes Juan-Les-Pins, France*

06/2016

### Stitching Inter-Domain Paths over IXPs

*ACM Symposium on SDN Research (SOSR), Santa Clara, USA*

03/2016

### A MIP for Aggregation and Multicast Trees under Flexible Routing and Function Placement

*International Symposium on Mathematical Programming (ISMP), Pittsburgh, USA*

07/2015

### KuVS Prize for the Best Master Thesis

*International Conference on Networked Systems (NetSys), Cottbus, Germany*

03/2015

### It's About Time: On Optimal Virtual Network Embeddings under Temporal Flexibilities

*IEEE International Parallel and Distributed Processing Symposium (IPDPS), Phoenix, USA*

05/2014

### VirtuCast: Multicast and Aggregation with In-Network Processing

*International Conference on Principles of Distributed Systems (OPDODIS), Nice, France*

12/2013

## References

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### Prof. Anja Feldmann, Ph.D.

Max-Planck-Institut für Informatik

✉ anja@mpi-inf.mpg.de

☎ +49 681 9325 3501

### Univ.-Prof. Dr. sc. Stefan Schmid

University of Vienna

✉ schmiste@gmail.com

☎ +43 1 4277 78610

### Prof. Georgios Smaragdakis, Ph.D.

Technische Universität Berlin

✉ georgios.smaragdakis@tu-berlin.de

☎ +49 30 314 75741

### Prof. Dr. Thomas Zinner

Norwegian University of Science and Technology

✉ thomas.zinner@ntnu.no