

# Heiko Röglin



## Academic career

2008	Dr. rer. nat., RWTH Aachen
2008	Visiting Researcher, Microsoft Research Asia, Beijing, China
2008 - 2009	Postdoctoral Research Fellow, Boston University, MA, USA
2009 - 2010	Assistant Professor, Maastricht University, Netherlands
2010 - 2013	Professor (W2), University of Bonn
Since 2013	Professor (W3), University of Bonn

## Honours

2008	Outstanding Paper Award of the 9th ACM Conference on Electronic Commerce
2010	Best Paper Award of the 7th International Conference on Swarm Intelligence
2012	ERC Starting Grant
2015	Teaching Award of the University of Bonn

## Offers

2013	Professor (W3), TU Hamburg
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## Invited Lectures

2013	38th Conference on the Mathematics of Operations Research, Lunteren, Netherlands
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## Research Projects and Activities

ERC Starting Grant "Algorithms beyond the Worst Case"  
ACM Conference on Economics and Computation (2011, 2014, 2016)  
Program committee member  
Conference on Web and Internet Economics (2012)  
Program committee member  
Symposium on Theoretical Aspects of Computer Science (2014)  
Program committee member  
DFG Cluster of Excellence "Hausdorff Center for Mathematics"  
Member  
Associate Editor  
of SIAM Journal on Discrete Mathematics

## Research profile

The focus of my current research lies on probabilistic analysis of algorithms for combinatorial optimization problems. It is a common phenomenon that the predominant concept of worst-case analysis yields too pessimistic results. Many algorithms are better (with respect to running time and quality of results) than such an analysis predicts because worst-case instances are often artificial and occur only rarely in applications. An important way to reduce the gap between theory and practice is to study the behavior of algorithms on random or randomly perturbed inputs. For many algorithms such a probabilistic analysis reveals that worst-case instances are fragile and not robust against random noise. We have shown, for example, that the expected running time of simple local search heuristics on randomly perturbed inputs is in many cases polynomial despite their very bad worst-case behavior. These results provide the first rigorous explanation for the practical success of local search for the traveling salesman problem and

other important optimization problems.

Probabilistic analysis of algorithm is a research area with many interesting and challenging open questions. I will continue my work in this area. While at the moment many ad-hoc methods are used, I plan to devise and study more general methods for the analysis of algorithms on randomly perturbed inputs in order to unify existing results and to broaden the range of applications. The insights gained from probabilistic analyses shall also lead to the design of better algorithms and techniques. As an example, better bounds on the diameter of totally unimodular polytopes were already proved using these insights.

## Supervised theses

Master theses: 30

Diplom theses: 5

PhD theses: 5, currently 4

## Selected PhD students

Tobias Brunsch (2014): “Smoothed Analysis of Selected Optimization Problems and Algorithms”

## Selected publications

- [1] Tobias Brunsch, Kamiel Cornelissen, Bodo Manthey, Heiko Röglin, and Clemens Rösner. Smoothed analysis of the successive shortest path algorithm. *SIAM J. Comput.*, 44(6):1798–1819, 2015.
- [2] Tobias Brunsch, Anna Großwendt, and Heiko Röglin. Solving totally unimodular lps with the shadow vertex algorithm. In *32nd International Symposium on Theoretical Aspects of Computer Science*, volume 30 of *LIPICs. Leibniz Int. Proc. Inform.*, pages 171–183. Schloss Dagstuhl. Leibniz-Zent. Inform., Wadern, 2015.
- [3] Tobias Brunsch and Heiko Röglin. Improved smoothed analysis of multiobjective optimization. *J. ACM*, 62(1):Art. 4, 58, 2015.
- [4] Matthias Englert, Heiko Röglin, and Berthold Vöcking. Worst case and probabilistic analysis of the 2-opt algorithm for the tsp. *Algorithmica*, 68(1):190–264, 2014.
- [5] Michael Etscheid and Heiko Röglin. Smoothed analysis of local search for the maximum-cut problem. In *Proceedings of the Twenty-Fifth Annual ACM-SIAM Symposium on Discrete Algorithms*, pages 882–889. ACM, New York, 2014.
- [6] Tobias Brunsch and Heiko Röglin. Finding short paths on polytopes by the shadow vertex algorithm. In *Automata, languages, and programming. Part I*, volume 7965 of *Lecture Notes in Comput. Sci.*, pages 279–290. Springer, Heidelberg, 2013.
- [7] Heiner Ackermann, Paul W. Goldberg, Vahab S. Mirrokni, Heiko Röglin, and Berthold Vöcking. Uncoordinated two-sided matching markets. *SIAM J. Comput.*, 40(1):92–106, 2011.
- [8] David Arthur, Bodo Manthey, and Heiko Röglin. Smoothed analysis of the k-means method. *J. ACM*, 58(5):Art. 19, 31, 2011.
- [9] Heiko Röglin and Shang-Hua Teng. Smoothed analysis of multiobjective optimization. In *2009 50th Annual IEEE Symposium on Foundations of Computer Science—FOCS 2009*, pages 681–690. IEEE Computer Soc., Los Alamitos, CA, 2009.
- [10] Heiner Ackermann, Heiko Röglin, and Berthold Vöcking. On the impact of combinatorial structure on congestion games. *J. ACM*, 55(6):Art. 25, 22, 2008.