

# New Concepts in Robust Optimization

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September 20, 2018

## Abstract

Most real-world optimization problems contain parameters which are not known at the time a decision is to be made. In robust optimization one specifies the uncertainty in a scenario set and tries to hedge against the worst case.

Classical robust optimization aims at finding a solution which is best in the worst-case scenario. It is a well-studied concept (see [1]), but it is known to be very conservative: a robust solution comes with a high price in its nominal objective function value.

This motivated researchers to introduce less conservative robustness concepts in the last decade, see the survey [2]. In the first part of this talk, two of such less conservative robustness approaches will be introduced and discussed: light robustness and a scenario-based approach to recovery robustness. While light robustness ensures a pre-defined nominal quality, recovery robustness allows to adapt a solution if the true scenario becomes known. It will be shown how algorithms for solving the deterministic problems can be adapted to find light robust and recovery solutions.

The second and main part of the talk goes one step further: how to handle uncertain optimization problems in which more than one objective function is to be considered? This yields a robust multiobjective optimization problem, a class of problems only recently introduced and studied, see [3]. Some concepts on how to define and visualize robust Pareto solutions will be introduced. Different concepts on how to define a robust Pareto solution will be shown: Scenario-based concepts, minimax concepts and a multi-objective approach [4]. Mathematical properties will be derived as well as first approaches on how to compute robust efficient solutions.

## References

- [1] A. Bel-Tal and L. El Ghaoui and A. Nemirovski. *Robust Optimization*. Princeton University Press, 2009.
- [2] M. Goerigk and A. Schöbel. Algorithm Engineering in Robust Optimization. In: Algorithm Engineering: Selected Results and Surveys, Ed: L. Kliemann and P. Sanders. *LNCS* **9220**, 245-279, 2016.
- [3] J. Ide and A. Schöbel. Robustness for uncertain multi-objective optimization: a survey and analysis of different concepts. *OR Spectrum* **38**:1, 235-271, 2016.
- [4] M. Botte and A. Schöbel. Dominance for Multi-Objective Robust Optimization Concepts. *European Journal of Operational Research*, to appear.

**Bio:** Anita Schöbel is head of the research group “Optimization” at the Faculty for Mathematics and Computer Science of the Georg-August University Göttingen.

After receiving her PhD in 1998 at the Technical University of Kaiserslautern, she worked as a postdoc at the Fraunhofer Institute for Industrial Mathematics for two years before she went back to university to receive her Habilitation in 2003. She received a position as associate professor in Göttingen in 2004 and has been full professor since 2007.

Her research interests focus on discrete optimization in public transportation, multi-objective robust optimization, and several topics related to facility location. She develops approaches based on integer programming, graph-based algorithms, and simulation.

She has been involved in many industrial and research projects, among them the European projects ARRIVAL and OptALI and cooperation with India. She is also the coordinator of the research unit on Integrated Transportation funded by the German Research Foundation (DFG). Anita is on the managing board of the German Society of Operations Research (GOR) and of the Center of Simulation Studies Clausthal-Göttingen (SWZ).

She is married and has two children.