SE-25.4 Robust Optimization with Application in Utility Network Design (S)

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Robust Optimization deals with computing feasible solutions for data which include uncertainties. Uncertain data typically occur in mathematical models for designing utility networks such as gas, hydrogen, water or power networks because of the inaccuracy of the predicted data. These uncertainties can appear, e.g., in predicted demands or costs as well as in the approximations of technical parameters. Uncertainties in the data make optimizing utility network designs even more complex because they increase the amount of data that has to be considered and consequently, lead to larger optimization problems.

We introduce a mathematical method for designing utility tree-shaped networks with uncertain data. These data consist of infinitely many scenarios which describe demand fluctuations at entry, exit, and storage nodes. In general, it is not possible to optimize a utility network design for infinitely many different scenarios. Our approach generates a finite set of scenarios, whose size is maximally quadratic in the number of nodes of the given network. We proved that optimizing the network design with respect to this set leads to a solution that is globally optimal for all original scenarios. At the end, we show the applicability of our results by optimizing the design of realistic utility networks.