Robust Solution Methods for Challenging Gas Network Operation Problems

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Abstract: One way of protecting against uncertainties that occur in real-world applications is to apply and to develop methodologies from robust optimization. In this talk, we focus on uncertainties in the operation of gas networks. A well-known example is the roughness value of the pipe that influences the friction of the gas and thereby effects the pressure loss between the endpoints of the pipe. However, the roughness depends on the contamination of the pipe and can only be measured with great effort. The challenge is to decide whether a set of demands can be satisfied by the network if not all characteristic data as, for instance, the roughness are known precisely. For the stationary setting, robust approaches are suggested here that are able to handle these uncertain physical parameters. In particular, it is shown that if, in case of a passive network, the pressure loss is modeled by the Weymouth equation, certificates for robust feasibility and infeasibility can be derived. The robustified problems can be rephrased as polynomial optimization problems in both cases and approximated using positive semidefinite programming. The practical relevance of the theoretical results are demonstrated by a set of small to medium size numerical examples. If active elements are involved, such reformulations are not possible, and methods are discussed for solving the corresponding robust counterparts. We conclude by pointing out some challenges in the field.

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