Checking Feasibility in Stationary Models of Gas Transportation Networks – Case Study

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Checking the feasibility of transportation requests belongs to the key tasks in gas pipeline operation. In its most basic form, the problem is to decide whether a certain quantity of gas can be sent through the network from prescribed entries to prescribed exit points. In the stationary case, the physics of gas flow together with technological and commercial side conditions lead to a pretty big (nonlinear, mixed-integer, finite dimensional) inequality system. Using the elimination and approximation techniques presented in the talk "'Checking Feasibility in Stationary Models of Gas Transportation Networks - Methodological Foundation"' the remaining system can be solved using standard NLP-solvers.
Within an industry project these ideas are applied to the planning tasks of the biggest german transportation system operators and it's real-world networks, comprising in total about 11.000 km of pipes.
As done for the traditionally used simulation tool the gas network is split in three parts – one for low-calorific gas (L-gas) and the northern and southern parts of the network for high-calorific gas (H-gas).
These three networks have different characteristics. While the L-gas network in its main part serves as a distribution network, both H-gas networks combine high-pressure transport lines with low-pressure distribution parts.
Besides the different numbers of network elements the complexity of the resulting transformed nonlinear problem differs due to the topologies of the networks, since each fundamental cycle correponds to one flow variable.
The L-gas network has a peculiarity: there is a couple of distribution regions being fed via control valves without remote access, i.e. with fixed output pressure. This allows for a decomposition of the problem.
Although the combinatorial character of the planning problem is tackled by a heuristic, the results for these real-world problems are at least very encouraging and of substantial use for network operators.

The talk presents the characteristics of these networks, the complexity of the resulting problems, and computational results.