MATHEMATICAL PROBLEMS RELATED TO GAS TRANSPORTATION NETWORKS

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Abstract. This presentation deals with mathematical modelling and optimisation of gas transportation networks. The network topology is modelled as a directed graph. The gas dynamics partial differential equations are simplified to get a nonlinear system of equations for which existence and uniqueness of solution are analyzed. The different elements that form a network, namely, compression stations, pressure control valves, flow control valves, closing valves, regasification plants, international connections and underground storages are included.

Managing the gas network becomes a really complex problem. Currently, the aim is to guarantee the security of the supply, independently of its associated costs. However, in the present work the latter are also considered so we are led to solve a mixed integer nonlinear optimization problem. Indeed, firstly there are a lot of nonlinear aspects, mainly due to the pressure loss in the pipes, the gas consumption and the operation range of the compressors. Secondly, there are binary decisions regarding whether or not a given valve or compressor is active.

We have developed a two-stage approach to tackle this complex problem. In the first stage the model equations are included as constraints in the optimization problem and an iterative algorithm based on suitable linear approximations is applied. In the second stage an optimal control problem formulation is considered to refine the results obtained in the first stage.

Based on the above mathematical methods, a computer program called GANESO^{TM} (GAs NEtwork Simulation and Optimization) has been developed. Real life examples obtained with this program will be presented.

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