On a model hierarchy for gas flow simulation

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The energy transition is a hot topic today in Germany. Natural gas plays a key role in our current and future energy supply, because it is storable and quickly available (but it flows slowly). However, the transportation of natural gas raises challenging mathematical questions.

In this talk, we will discuss a model hierarchy for the simulation of the flow of natural gas through pipelines. Starting with the Euler equations, this hierarchy simplifies the model by assuming, for example, that the temperature is constant or that we have a steady-state situation. In the most simplified model, where we have purely algebraic equations, we perform an error analysis by considering the propagation of computational rounding errors and data errors. The theoretical results are compared to a statistical simulation of the algebraic model using the Univariate Reduced Quadrature method.

The results of the error analysis are discussed, indicating a maximum pipeline length for which the algebraic model can be used safely.