Applied Mathematics

On Stabilized Finite Element Methods for Pressure Driven Flows of Rarefied Gases through Long Channels

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A steady flows of rarefied single gases through a long channel with arbitrary cross section are studied. The gas is modeled by the linearized Bhatnagare-Grosse-Krook kinetic equation with diffuse reflection boundary condition. The discrete velocity and streamline diffusion finite element methods are combined to yield a numerical scheme. For this scheme we derive stability and optimal convergence rates in the L_2-type norms. The optimality is due to the maximal available regularity of the exact solution for the corresponding hyperbolic pde. This solution yields the dimensionless flow rate and the velocity profile for a wide range of the gaseous rarefaction. Discrete velocity model in our study can be extended to the case of mixtures, viz [3]. Some related numerical studies can be found in, e.g., [1], [2] and [4].
This is joint work with Ehsan Kazemi.

References

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