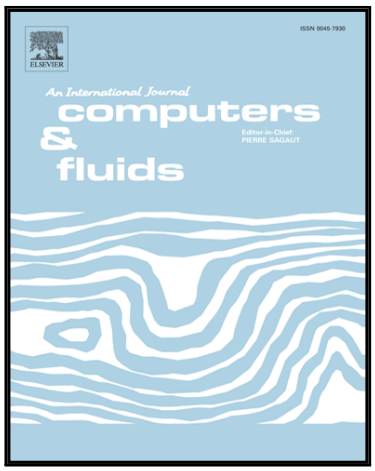

Re-print of Finite volume methods for multi-component Euler equations with source terms

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Re-print of Finite volume methods for multi-component Euler equations with source terms

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Abstract

A first-order well-balanced finite volume scheme for the solution of a multi-component gas flow model in a pipe on non-flat topography is introduced. The mathematical model consists of Euler equations with source terms which arise from heat exchange, and gravity and viscosity forces, coupled with the mass conservation equations of species. We propose a segregated scheme in which the Euler and species equations are solved separately. This methodology leads to a flux vector in the Euler equations which depends not only on the conservative variables but also on time and space variables through the gas composition. This fact makes necessary to add some artificial viscosity to the usual numerical flux which is done by introducing an additional source term. Besides, in order to preserve the positivity of the species concentrations, we discretize the flux in the mass conservation equations for species, in accordance with the upwind discretization of the total mass conservation equation in the Euler system. Moreover, as proposed in a previous reference by the authors, [5], the discretizations of the flux and source terms are made so as to ensure that the full scheme is well-balanced. Numerical tests including both academic and real gas network problems are solved, showing the performance of the proposed methodology.

Keywords: Multi-component gas flow, non-linear hyperbolic systems with sources, segregated scheme, finite volume method, well-balanced scheme.

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