A class of hyperbolic three-phase flow models

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Abstract

We present here a class of models to describe three-field patterns or three-phase flows. The basic ideas rely on the counterpart of the two-fluid two-pressure model which has been introduced in the DDT framework, and has been more recently extended to liquid-vapour simulations. We first present a class of hyperbolic systems without any constraining condition on the flow patterns. We then focus on a particular system which is the counterpart of the Baer-Nunziatto model which is used within the framework of the DDT theory. We detail the structure of single waves in the Riemann problem. Smooth solutions of the whole system agree with physical requirements on void fractions, densities, specific entropies. We show that shock solutions make sense. When using relaxation techniques, this model enables to perform computations of single pressure three-phase flow models on coarse meshes. Admissible forms of mass, energy and momentum transfer terms are discussed. A simple fractional step method is used to compute approximations of solutions, and a few computational results illustrate the whole approach.

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