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A Relaxed Navier-Stokes-Korteweg Model

In the last decade diffuse-interface and phase field models have been developped as basis for the numerical simulation of compressible two-phase flow with phase transition. Among others a basic modelling approach in this framework are the Navier-Stokes-Korteweg equations (NSK). Using Van-der-Waals type pressure functions the first-order (Euler) part of the NSK equations is of mixed hyperbolic-elliptic type while the dissipative part contains up to third-order derivatives. This makes the numerical solution quite challenging. However, the major drawback of these equations is the strong coupling of interfacial width and the effective surface tension as a material property. For realistic scenarios, e.g. water systems,the choice of the coupling parameter requires a spatial resolution that cannot be realized with nowadays numerical and computational possibilities. Motivated by work of Jamet we will present a modification of the model to reduce the coupling and to enlarge the interface for given surface tension. The idea is to approximate the NSK system by a (generalized) relaxation system. Interestingly the modification makes the Euler part of the system purely hyperbolic in the limit of vanishing relaxation parameter. We will present first numerical tests for the modified system. From the theoretical point of view we will consider a scalar equations which reflects at least some of the properties of the full system. In this case our modification can be interpreted as a singular perturbation of the original equation and can be fully analyzed. This is joint work with Andrea Corli and Jochen Neusser.