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Interfacial pressures and shocks in a multiphase flow model

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Multiphase flow models[1] have been proposed for use in situations which have combined Rayleigh-Taylor (RTI) and Richtmyer-Meshkov (RMI) instabilities[2]. This approach works poorly for the case of a heavy to light shock incidence on a developed interface. Such models can be derived and all the approximations made explicit in the same sense that Reynolds Averaged Navier-Stokes (RANS) turbulence models are "derived." Such derivations produce correlations in the RANS sense and also surface terms which are unique to multiphase flow models. These derivations lend insight into the validity of the approximations in the model. The physical original of this difficulty is traced to an inadequate model of the interfacial pressure term as it appears in the momentum and turbulence kinetic energy equations. In this context it is observed that a new constrain on the closures arises. (Such constrains exists on the terms in any model which contains shocks.) This occurs because of the discontinuity within the shock responsible for the RMI. A form is proposed and implemented in a multiphase flow model following the work of Youngs. Comparisons made to the experiments of Vetter and Sturtevant[3] and also of Erez[4]. The proposed model (Shock Scattering) is shown to give useful results.

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References

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