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A hierarchy of two-fluid models with specific numerical methods for the simulation of bubbly flows/acoustic interactions FLORENCE DRUI, ADAM LARAT, VINCENT LE CHENADEC, EM2C laboratory - CNRS UPR288/Fédération de mathématiques de l'Ecole Centrale Paris - CNRS FR 3447, SAMUEL KOKH, Maison de la Simulation - USR 1441, MARC MASSOT, EM2C laboratory - CNRS UPR288/Fédération de mathématiques de l'Ecole Centrale Paris - CNRS FR 3447 — Simulating the injection, evaporation, and combustion of fuel in energy conversion applications represents a major challenge. The formulation of closed sets of equations able to accurately predict these complex systems by relying solely on averaged information has been a longstanding problem. As a consequence, no simple model is currently available that describes the complete injection process, known to range from the separated phase regime in the early stages of atomization to the dispersed regime that occurs further downstream. The benefits of such a unified formulation would be significant, both in terms of computational cost and algorithmic complexity. In order to identify the challenges in formulating one such approach, a one-pressure, one-velocity isothermal two-fluid model for bubble-acoustic wave interaction is studied and incrementally improved by introducing additional variables that characterize the micro-structure of bubbles. The elastic and dissipative structures of the models are investigated in depth, and their performances compared to reference solutions (Drew & Passman, 1999). Numerical strategies are devised which can accurately handle the whole hierarchy and related stiffness, and rely on Suliciu's relaxation method as well as an asymptotic-preserving treatmen

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