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CAPTURING OF INTERFACE EVOLUTION USING DIFFUSE INTERFACE METHOD

Andrzej F. Nowakowski, Ahmed Ballil, Shaban A. Jolgam, Franck C.G.A. Nicolleau
Sheffield Fluid Mechanics Group,Mechanical Engineering Department,
University of Sheffield, Sheffield S1 3JD, United Kingdom.
E-mail: a.f.nowakowski@sheffield.ac.uk

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In the present contribution the diffuse interface method is used to track the bubble evolution in multi-component flow systems. Multi-component flows with interface interactions and significant density variations occur in many industrial applications and physical phenomena. Good example are cavitations, fuel injection and atomisation systems. These problems could be addressed using different mathematical models and numerical methods. The technique classified as a diffuse interface method has been chosen in this study as an attractive option to mathematically represent and numerically simulate flows with interfaces. The method considers interfaces (for example contact discontinuities in gas dynamics) as numerically diffused zones taking advantage of inherent numerical diffusion. The formulation for the diffuse interface method was obtained after an averaging process of the single phase Navier-Stokes equations.

The six equation Eularian model used in this study was originally derived by Kapila *et al.,* (2001) from the generic mathematical framework proposed by Bear and Nunziato, (1986). The Euler-type equations representing this model were solved numerically using a second order Godunov method which was developed and implemented with HLL and HLLC Riemann solvers in one and two space dimension. In order to circumvent the difficulties related to the model's mechanical equilibrium and maintenance of volume fraction positivity, this newly developed numerical approach considers an additional total mixture energy equation which was derived by Saurel *et al*., (2009).

The numerical results are presented for a selection of benchmark cases, which were previously used to test other mathematical models and numerical techniques. Here we present a sample of the results for 2D problems. Other standard cases for 1D problems can be found in Nowakowski *et al*., (2011). Figure 1 presents the computational domain and the initial configuration of the test involving the interaction of a shock wave with a helium bubble. The shock wave propagates from right to left in the air and impacts the helium bubble. This test was earlier investigated experimentally by Leyes and Le Métayer, (2007). Figure 2 shows numerically obtained maps of the mixture density which were recorded at various moments of the simulation and postprocessed using the idealised Schlieren function. One can notice that as a consequence of the shock interaction with the helium bubble the gas bubble evolves generating two symmetric structures. The HLL Riemann solver, the mesh resolution of 900 by 240 and general stiffened gas equations of state for each constituents were used.

The obtained results for all investigated cases confirm the physical behaviour of the two-component flow problems and show good agreement with available reference analytical (obtained from the exact solution to the Riemann problem) or experimental data.

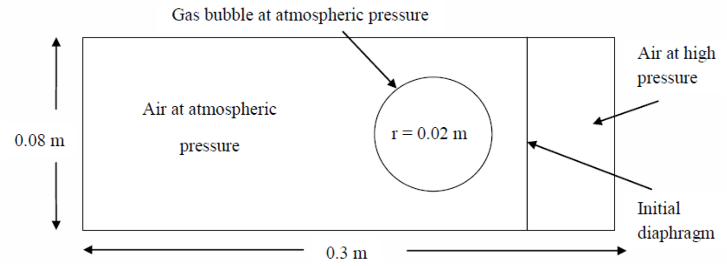

Fig. 1. Schematic diagram of the initial configuration of the shock-bubble interaction test.

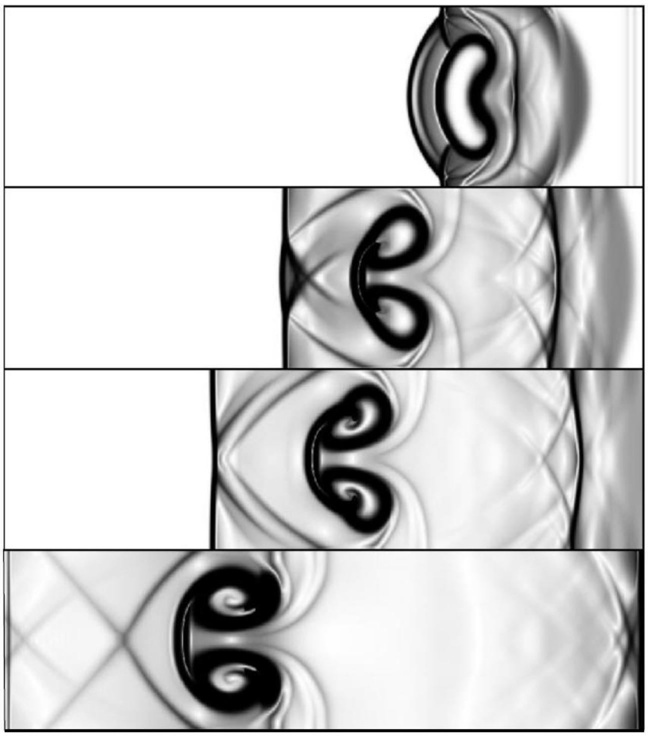

Fig. 2. The mixture density for the helium bubble-air constitution at times 134 μs; 274 μs; 344 μs and 554 μs from top to bottom.

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