Simulation of gas-bubble deformation using higher-order multicomponent approach for compressible flows

Andrzej F. Nowakowski* **and Franck C. G. A. Nicolleau†**

* Sheffield Fluid Mechanics Group
Department of Mechanical Engineering, University of Sheffield
Mappin Street, Sheffield, S1 3JD, United Kingdom
e-mail: a.f.nowakowski@sheffield.ac.uk

† Sheffield Fluid Mechanics Group
Department of Mechanical Engineering, University of Sheffield
Velocity Village, Solly Street, Sheffield, S1 4DE, United Kingdom
e-mail: f.nicolleau@sheffield.ac.uk

ABSTRACT

Results of the simulations of flows in inhomogeneous media of various physical regimes leading to shock-bubble interactions will be presented using a developed numerical approach based on a multicomponent flow model. The mathematical formulation results from an averaging process of the single phase Navier-Stokes equations. It contains non-conservative equations and non-conservative terms which are necessary to capture interfaces represented by contact discontinuities. The formulation treats each component of the flow with its own equation of state. In previous work [1] the authors solved the equations using a finite volume Godunov type computational technique, equipped with an approximate Riemann solver for calculating fluxes. The approach accounted for pressure non-equilibrium and enabled the resolution of flow component interfaces. In the present contribution this approach is further developed to utilise higher-order numerical discretization techniques based on the discontinuous Galerkin method. The numerical results demonstrate the efficiency of the new approach for various initial conditions promoting a shock-bubble interaction. The results will be presented for different parameters related to the initial flow topology of the heterogeneous media, their constituents' Atwood number and shock wave Mach number.

REFERENCES

[1] Nowakowski, A.F., Ballil, A and Nicolleau, F.C.G.A. Passage of a shock wave through inhomogeneous media and its impact on gas-bubble deformation. *Phys. Rev. E*, Vol. **92**, 023028, (2015).