Three-dimensional simulation of a shock induced bubble collapse

E. Goncalves[1]*, P. Parnaudeau[1]

[1] Pprime, UPR 3346 CNRS, ISAE-ENSMA, Université Poitiers 86961 Chasseneuil cedex, France
eric.goncalves@ensma.fr, philippe.parnaudeau@univ-poitiers.fr

Key Words: *Shock-bubble interaction, one-fluid simulation, blast wave, jet formation.*

The investigation of the pressure developed by a collapsing cavitation bubble is of primary interest for hydraulic turbomachineries, fuel injectors, naval propulsion systems and biomedical technologies. One of the most critical consequences is the shock wave emitted by bubbles collapse and the structural damage resulting when this process takes place close to solid walls. This paper presents a numerical study of the interaction between a planar incident shock wave with a gas bubble. Simulations are performed using an inviscid compressible one-fluid solver composed by three conservation laws for mixture variables, namely mass, momentum and total energy along with a supplementary transport equation for the volume fraction of the gas phase [1-2]. Three-dimensional simulations are compared with the 2D reference case similar to the one presented in [3]. The mesh is composed by 1600x800x800 nodes. The time integration is done using a 3-step Rung-Kutta method and the numerical fluxes are computed with a second-order HLLC scheme.

The main features of the interaction is described (figure 1, right). Evolution of the maximum pressure during the collapse is compared between 2D and 3D simulations (figure 1, left). It shows the large discrepancy between the cylindrical and the spherical collapse. The case near a rigid wall is also studied. We consider the case for which the distance between the bubble center and the wall is 1.66 radius. The pressure evolution on the wall is investigated and comparisons between 2D and 3D simulations are proposed.

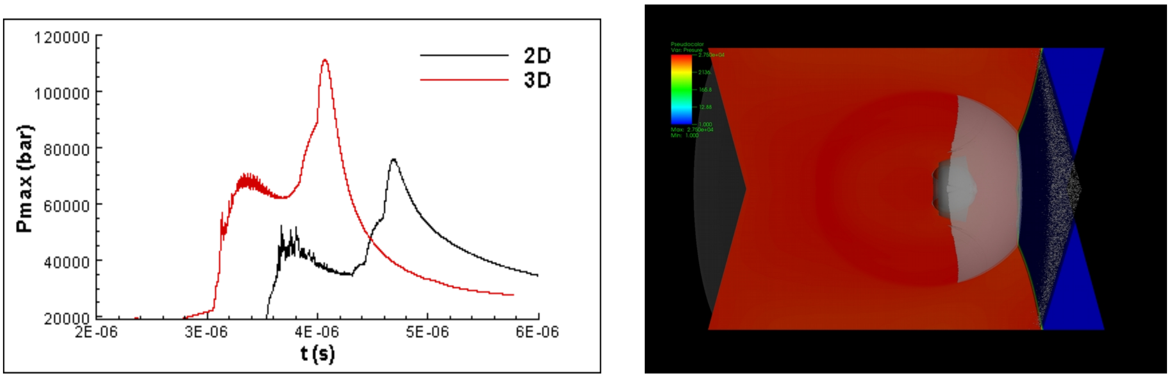

Fig 1: Maximum pressure evolution (left) and instantaneaous 3D pressure field (right).

REFERENCES

[1] E. Goncalves, B. Charriere, Modelling for isothermal cavitation with a four-equation model, *Int. J. Multiphase Flow*, Vol. **59**, pp. 54-72, 2014.

[2] E. Goncalves, D. Zeidan, Simulation of compressible two-phase flows using a void ratio transport equation, *Comm. Comput. Physics*, in press, 2017.

[3] R.R. Nourgaliev, T.N. Dinh, and T.G. Theofanous, Adaptive characteristics-based matching for compressible multifluid dynamics, *J.Comput. Physics*, Vol. **213**, pp. 500-529, 2006.