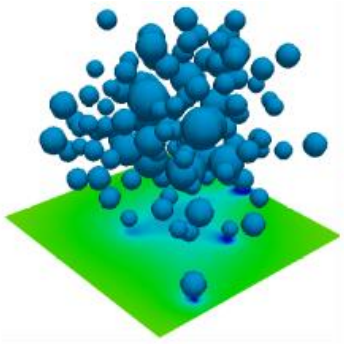
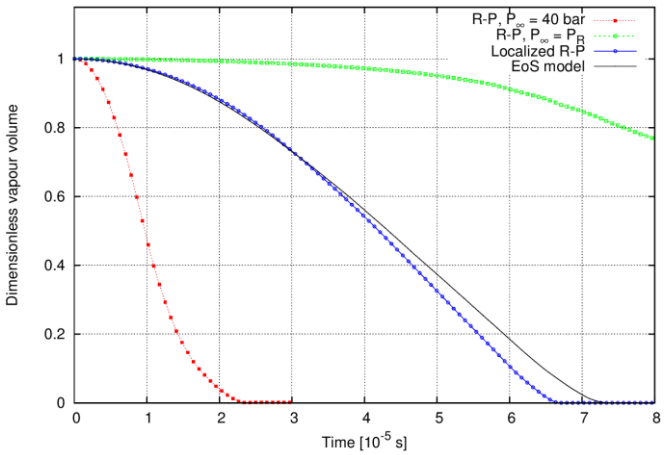
Summary of Deliverable D3.4: DNS-based SGS for LES model validation

provided by ESR 8, Mr Ebrahim Ghahramani, under the guidance of Prof. Rickard Bensow, Chalmers University of Technology, September 2018



Representation of a cavity cloud as a cluster of Lagrangian bubbles



Time history of bubble cloud volume using Lagrangian model with different forms of the Rayleigh-Plesset equation

Cavitating flows include an extensive range of cavity structures with different length scales, from micro bubbles to large sheet cavities that may fully cover the surface of a device. To avoid high computational expenses, incompressible transport equation based, homogeneous mixture models are considered as a practical option for simulation of large scale cavitating flows, normally with limited representation of the small scale vapour structures. To improve the resolution of all scales of cavity structures in these models, a possible approach is to develop a hybrid Eulerian mixture- Lagrangian bubble solver in which the larger cavities are directly resolved in the Eulerian framework and the small (sub-grid) structures are tracked as Lagrangian bubbles. In the Lagrangian model, the continuum flow field is solved similar to the Eulerian mixture approach, however the cavities are resolved by individual bubbles. In this report, the model is validated in simulation of cavitating bubbles and the developed Lagrangian model results are compared with other cavitation models, including previously developed Lagrangian models in literature. In this comparison, different ways to consider how the fluid pressure influences bubble dynamics are studied, including a novel way by considering the local pressure effect in the Rayleigh-Plesset equation. This comparative study is achieved by simulating two benchmark tests cases. The first case is the Rayleigh collapse of a single bubble, which helps to understand the model behaviour in capturing the cavity interface and the surrounding pressure variations. The second investigated case is the collapse of a cluster of bubbles, where the collapse of each bubble is affected by the dynamics of surrounding bubbles. This case confirms the importance of considering local pressure in the improved form of the Rayleigh-Plesset equation