6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11 - 15 June 2018, Glasgow, UK

ACOUSTICS SIMULATION IN THE PRESENCE OF MOVING INTERFACES IN MULTIPHASE FLOWS

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Key words: *Multiphase flow, Acoustics, Surface Tension, Moving Interfaces*

One of the simplest cases for multiphase acoustics in which all basic physically relevant mechanisms occur is a fluid drop impacting in a fluid pool. It is not completely understood where the sound is produced when the drop hits the surface. Numerical simulations can help to understand the mechanisms of sound producing sources. In this work a numerical scheme for calculation surface tension dominated multiphase flows coupled with acoustics is presented.
The Volume-of-Fluid (VOF) method is used to calculate the multiphase flow. Surface tension is taken into account by the use of the Continuum Surface Force (CSF) method with different models for curvature computations. An Expansion about Incompressible Flow (EIF) approach using the Linearized Euler Equations (LEE) is employed for the acoustics. Both parts are calculated within a finite volume Navier-Stokes solver framework, where a one-directional coupling is employed. It is assumed that the fluid flow operates at a higher energy level than the sound waves. For this reason the acoustic sources are produced by the fluid flow, but the acoustic field has no influence on the fluid flow.
One difficulty in calculating the acoustic field in multiphase flows is the jump of the material properties at an interface [1]. Good interface representation in the VOF environment as well as adjustments in the acoustic solver are necessary. With a fixed inclined interface the coupled code has shown to calculate the acoustic wave propagation, transmission and reflection in a heterogeneous media domain with an error less than one percent [2].
With a moving interface non-physical acoustic sources arise in the interface region due to the moving material jump. To address this issue the LEE has to be adjusted correspondingly. Additional source terms are included and investigated. This approach is tested with a bubble moving through a duct where the additional source terms lower the production of sound in the interface region. Further an oscillating bubble with suppressed sources in the interface is compared with the new approach to show the matching frequencies of the sound pressure and oscillation. The simulation of an impacting fluid drop in a pool is considered as a test case.

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