Eindimensionale Modellierung von Kavitationswolken in kompressibler Strömung

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The present work analyses the dynamics of cloud cavitation in a compressible flow. Recent experiments highlight that a common cloud geometry for cavitation clouds is a horseshoe. With the Helmholtz vortex theorem in mind, the horseshoe is artificially completed to be a generic torus shaped cloud. Following van Wijngaarden, the mixture of cavitation bubbles and liquid inside the cloud is treated as a continuous medium, i.e. a homogenous model with the void fraction α and the single bubble radius R. By doing so, the bubble radii are a function of the radial position inside the cloud and time only. The individual bubble dynamics depend on the given dynamic and kinematic boundary conditions of the model. A pressure history at infinity and a strain rate or circulation represent these two types of excitations. The problem results in a system of non-linear differential equations consisting of the Gilmore equation, the continuity equation and the Euler equation. The Gilmore equation describes the dynamics of the individual bubbles inside the cloud whereas the continuity and Euler equations describe the movement and interaction of the bubbles.

The resulting pressure and the bubble radii inside the cloud as well as the cloud radius are highlighted and analysed. They depend on the excitation of the cloud and the different time scales of the system.

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