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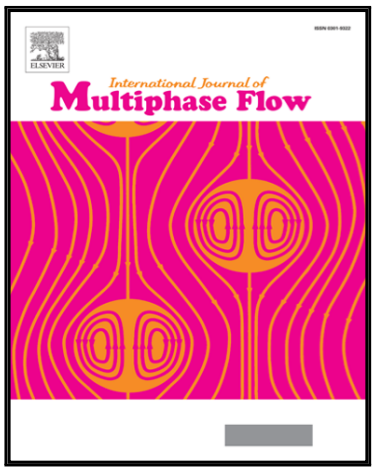


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# An Exact Multiphase Riemann Solver for Compressible Cavitating Flows

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## Abstract

This paper presents a new one-fluid method for simulating formation and the collapse of cavitation regions in water during an isothermal process. In this method, the fluid phase changes are included into the wave pattern of an exact Riemann solver. The model behavior is assessed by comparing the numerical results with the other numerical models for several 1D Riemann problems. One-dimensional water hammer problems with vast creation and collapsing of cavitation zones are simulated as well – and the numerical results are compared to experimental results. The new model results are in very good agreement with accepted results reported in the literature. The presented results clearly show that the new model is able to capture the various behaviors of water during the phase change in the saturation dome and the vapor state, which was neglected in previous studies. Finally, the new model is adopted to an ALE method on an adaptive triangular grid to simulate an underwater explosion phenomenon inside a rigid cylinder – and the results are compared with other simulations.

## Keywords

Riemann solver, cavitation, one-fluid method, equation of state, compressible flow, multiphase flow

## 1. Introduction

Formation of vapor regions in a fluid due to a drastic pressure drop below the saturation pressure is called the cavitation (Arndt, 1981; Rachid and Felipe, 2003). This phenomenon usually occurs in transient compressible fluid flow. Transient (unsteady) cavitation includes complex physical phenomena such as the formation of a cavitation zone with a dynamic

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