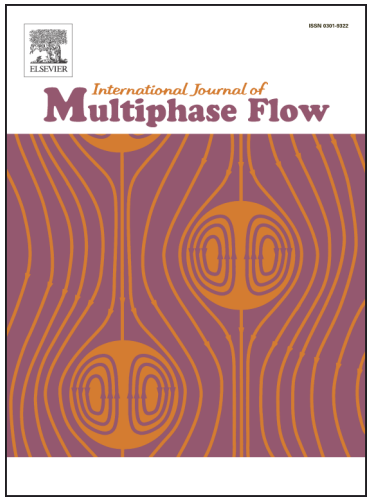

Effects of Confinement on Bubble Dynamics in a Square Duct

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Effects of Confinement on Bubble Dynamics in a Square Duct

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Abstract

In this paper, we simulate the effects of confinement on three-dimensional bubble dynamics in a square duct. A systematic study of three confinement ratios, four Bond numbers and two Morton numbers has been conducted. A GPU implemented VOF numerical algorithm on a Cartesian collocated grid with an improved method to handle the surface tension force has been developed. A three-dimensional geometry construction method with a piecewise linear interpolation scheme for approximating the interface segments is used to compute the interface shape and liquid volume flux from the cell faces. The Navier-Stokes equations are solved with a space-time second-order accurate fractional step numerical scheme. The surface tension force is treated as a pressure gradient and an additional Poisson equation is solved. Transient and steady state bubble deformations, rise velocities and aspect ratios are presented.

Keywords: Gas-liquid flows; Bubble dynamics; VOF; confinement; square duct

1 Introduction

The dynamics of a single buoyant bubble in a stagnant liquid is a classical problem in fluid mechanics and has attracted the attention of numerous researchers for well over a century.

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