

Evolution of a Pair of Spherical Bubbles Rising Side by Side at Moderate Reynolds Number

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The three-dimensional incompressible flow past two identical spherical clean bubbles moving side by side in a viscous fluid is studied numerically, allowing us to describe the interaction between the two bubbles over a wide range of Reynolds number and separation distance. The results enlighten the role of the vorticity generated at the bubble surface in the interaction process. When vorticity remains confined close to each bubble, the interaction is dominated by an irrotational mechanism and yields an attractive transverse force. In contrast, when viscous effects are sufficiently strong, the vorticity field about each bubble interacts with that about the other bubble, resulting in a repulsive transverse force. Using these computational results we show that, depending on their initial separation, freely-moving bubbles may either reach a stable equilibrium separation or move apart from each other up to infinity, which strongly contrasts with the conclusions of the potential flow approximation.

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