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Dynamics of the central entrapped bubble during drop impact

ZHEN JIAN[1], MURAD ALI CHANNA, MARIE-JEAN THORAVAL, State Key Lab for Strength and Vibration of Mechanical Structures, Int Center for Applied Mechanics, School of Aerospace, Xi'an Jiaotong University — When a drop impacts onto a liquid surface, it entraps a thin central air disk. The air is then brought towards the axis of symmetry by surface tension. This contraction dynamics is very challenging to capture, due to the small length scales (a few micrometers thin air disk) and time scales (contracting in a few hundred microseconds). We use the open source two-phase flow codes Gerris and Basilisk to study this air entrapment phenomenon. The effects of liquid properties such as viscosity and surface tension, and of the impact velocity were investigated. We focus on the morphology of the contracting air disk. The bubble is expected to contract into a single spherical bubble. However, in some cases, the air can be stretched vertically by the liquid inertia and split into two smaller bubbles. The convergence of capillary waves on the air disk towards the axis of symmetry can also make it rupture at the center, thus forming a toroidal bubble. In other cases, vorticity shedding can deform the contracting bubble, leading to more complex structures. A parameter space analysis based on the Reynolds and Weber numbers was then done to classify the different regimes and explain the transitions.

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