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Study of nonlinear free-surface spike induced by bubble

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The strong interaction between bubble and free surface is simulated numerically in this paper. A downward Bjerknes jet would form for the case of weak buoyancy force, while a spike would form on the free surface. When the bubble-free-surface distance varies, different kinds of spikes may be observed after the jet impact, among which a "crown" spike was discovered by Zhang A-man in their experiments [Zhang A M, Wang C, Wang S P, Cheng X D 2012. *Acta Phys. Sin.* **61** 084701]. A boundary element method with some numerical techniques is adopted to study this interesting phenomenon. Due to jet impact and liquid compressibility, about 70% system energy would lose when the bubble reaches a minimum volume[Lee M, Klaseboer E, Khoo B C 2007 *J. Fluid Mech.* **570** 407]. Besides, the toroidal bubble keeps moving away from the free surface, which results in a weaker interaction between them. Therefore, the evolution of the toroidal bubble is simulated till its minimum volume is attained. After that, the calculation of the free-surface motion is continued without regard to the effect of bubble. The validation of our numerical model is confirmed by its good agreement with an experiment conducted. Some calculation results are presented to illustrate the formation mechanism and the influence factors of crown spike.

REFERENCES

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