Numerical and experimental study of pressure-wave formation around an underwater ventilated vehicle

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Abstract

The objective of this study was to understand better the ventilated cavitation flow structure around an underwater ventilated vehicle. A high-speed camera system was used to observe the cavity evolution of unsteady cavitation flow, and a dynamic pressure measurement system was used to measure the instantaneous pressure during cavity growth. The numerical simulation is presented using the secondary development of computational fluid dynamics code CFX with a filter-based turbulence model. The results indicate that the ventilated flow rate of the gas influences the development of ventilated cavitation, and the pressure fluctuation is suppressed remarkably by the ventilated cavity evolution. The results also indicate that the proposed method can effectively capture the unsteady cavitation structure in accordance with the quantitative features observed in the experiment. It can therefore be concluded that the pressure fluctuations are induced by the vortex because of its periodic shedding toward downstream. The vortex shedding causes changes in the pressure distribution on the vehicle surface. Some secondary pressure oscillations can be observed that are attributable to the shedding of secondary vortex structures near the vehicle surface. These findings provide an important basis for facilitating the better understanding of the unsteady ventilated cavitation flows.