Partial Cavity Shedding Due to the Propagation of Shock Waves in Bubbly Flows

By
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Abstract

Partial cavitation on a wedge is studied in a re-circulating water tunnel to identify the regimes of transition from sheet to cloud cavitation. Using time resolved X-ray densitometry, time resolved 2-D void fraction flow fields in these cavities are obtained to identify the mechanisms of transition from closed partial cavities to open cavities exhibiting periodic shedding of large gas pockets. From the void fraction field measurements, two distinct types of cavity shedding mechanisms are identified: shedding associated with a re-entrant jet in the cavity closure region that produces intermittent shedding of smaller scale cavities, and large scale, periodic cloud shedding caused by the formation of a condensation shock within the high void-fraction flow in the separated region of partial cavitation. A discussion of the observed occurrence and properties of the shock wave, and its role in causing periodic shedding is presented based on the one-dimensional model of shock propagation in bubbly mixtures.

Short Biography

Steven L. Ceccio is Professor of Naval Architecture and Marine Engineering and of Mechanical Engineering and Applied Mechanics at the University of Michigan. He received his B. S. degree in mechanical engineering from the University of Michigan in 1985, his M. S. degree in 1986, and his Ph. D. in 1990 in mechanical engineering from the California Institute of Technology. He served as an Associate Vice President for Research at the University of Michigan from 2004 to 2009, and he is currently Chair of the Naval Architecture and Marine Engineering department. He is also the Director of the Naval Engineering Education Center. Prof. Ceccio’s research focuses on the fluid mechanics of multiphase flows and high Reynolds number flows. Specific research topics include flow in propulsors and turbomachinery, cavitating flows, vortical flows, friction drag reduction using bubble and polymer injection, the dynamics of liquid-gas, gas-solid, and three-phase disperse flows, and the development of flow diagnostics. Prof. Ceccio is a fellow of the American Society of Mechanical Engineers and of the American Physical Society.