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Bubble Augmented Propulsor Mixture Flow Simulation near Choked Flow Condition[1] JIN-KEUN CHOI, CHAO-TSUNG HSIAO, GEORGES CHAHINE, Dynaflow, Inc. — The concept of waterjet thrust augmentation through bubble injection has been the subject of many patents and publications over the past several decades, and computational and experimental evidences of the augmentation of the jet thrust through bubble growth in the jet stream have been reported. Through our experimental studies, we have demonstrated net thrust augmentation as high as 70%for air volume fractions as high as 50%. However, in order to enable practical designs, an adequately validated modeling tool is required. In our previous numerical studies, we developed and validated a numerical code to simulate and predict the performance of a two-phase flow water jet propulsion system for low void fractions. In the present work, we extend the numerical method to handle higher void fractions to enable simulations for the high thrust augmentation conditions. At high void fractions, the speed of sound in the bubbly mixture decreases substantially and could be as low as 20 m/s, and the mixture velocity can approach the speed of sound in the medium. In this numerical study, we extend our numerical model, which is based on the two-way coupling between the mixture flow field and Lagrangian tracking of a large number of bubbles, to accommodate compressible flow regimes. Numerical methods used and the validation studies for various flow conditions in the bubble augmented propulsor will be presented.

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