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Multiscale Modeling of Cavitating Bubbly Flows[1] J. MA, C.-T. HSIAO, G.L. CHAHINE, Dynaflow, Inc — Modeling of cavitating bubbly flows is challenging due to the wide range of characteristic lengths of the physics at play: from micrometers (e.g., bubble nuclei radius) to meters (e.g., propeller diameter or sheet cavity length). To address this, we present here a multiscale approach which integrates a Discrete Bubble Model for dispersed microbubbles and a level set N-S solver for macro cavities, along with a mesoscale transition model to bridge the two. This approach was implemented in 3DYNAFS© and used to simulate sheet-to-cloud cavitation over a hydrofoil. The hybrid model captures well the full cavitation process starting from free field nuclei and nucleation from solid surfaces. In low pressure region of the foil small nuclei are seen to grow large and eventually merge to form a large scale sheet cavity. A reentrant jet forms under the cavity, travels upstream, and breaks it, resulting in a bubble cloud of a large amount of microbubbles as the broken pockets shrink and travel downstream. This is in good agreement with experimental observations based of sheet lengths and frequency of lift force oscillation.

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