LPT with random walk model and interPhaseChangeFoam with non-homogeneous nuclei distribution.

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Abstract

Recently, many cavitation models have been introduced in order to fully describe the observed phenomena on cavitating hydrofoils. Cavitation occurs under different conditions of pressure in the presence of cavitation nuclei. Therefore taking account of the non-homogeneous nuclei content improve the accuracy of numerical simulations. Sauer [1] included the nuclei density parameter in its mass transfer cavitation model and set it as a constant n0. Experiments and numerical results [2] show that the nuclei accumulate in certain regions close to the hydrofoil and that the increased cavitation nuclei density in regions of low pressure affects the inception and development of cavitation.

The nuclei in the liquid phase are modeled with a Lagrangian Particle Tracking method. The solver is based on the solidParticle class. Particles respond through a Lagrangian equation of motion to the fluid velocity computed previously from a Eulerian converged solution with a RANS model. The effect of turbulent dispersion of the particles has to be included. Indeed small particles have a short relaxation time and respond quickly to the flow fluctuations. Turbulence diverts the particles from their trajectory and small particles are trapped in eddies for a certain period of time. Random walk models [3] consists on adding randomly eddies which affect the particle trajectory. We describe the implementation of a random walk model in the solver and its influence on the averaged nuclei distribution.

Sauer model is implemented in OpenFOAM under the name interPhaseChangeFoam. Modifications made to account for non-homogeneous nuclei distribution are presented together with results of cavitation inception and development for different initial non-uniform nuclei contents.

Key words: Cavitation, Sauer model, Nuclei density, Random walk, OpenFOAM

References

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