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Stochastic field modeling of cavitating flows in OpenFOAM[1]

MICHAEL RANFT, Institute for nuclear and energy technology, Karlsruhe Institute of Technology, Germany, ANDREAS G. CLASS, Areva nuclear professional school, Karlsruhe Institute of Technology, Germany — In [1] analysis is presented for a fluidic diode with low/high pressure drop in forward/reverse flow direction. Accurate description of cavitation is needed due to the dominant effect of vapor bubbles on sound speed. The stochastic field method developed in [1] represents the statistics of growing cavitation bubbles by a set of stochastic fields of vapor fraction which evolve according to the Rayleigh-Plesset equation and local instantaneous LES flow conditions. Cavitation may originate from nucleation sites in the core of turbulent vortices. In this work a RANS model is used instead of LES. Local turbulent pressure fluctuations are recovered based on kinetic energy k of turbulence and its Dissipation ε. In the Rayleigh-Plesset equation these fluctuations are represented by a Wiener process which is superimposed on the mean pressure. Usually a set of stochastic fields is introduced for each stochastic variable. Here two independent Wiener processes, both acting on the vapor-fraction stochastic fields, drive the evolution of vapor bubble growth, so that a single set of stochastic fields can be maintained. The proposed methodology is implemented in OpenFOAM and applied to verification cases including the fluidic diode.

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