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Towards DNS/LES of cavitating flows in complex geometries[1]
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We are developing a numerical method for DNS/LES of turbulent cavitating flows in complex geometries. The multiphase medium is represented using a homogeneous equilibrium model that assumes thermal equilibrium between the liquid and the vapor phase. The governing equations are the compressible Navier Stokes equations for the liquid/vapor mixture along with a transport equation for the vapor mass fraction. A separate total energy equation is solved, as opposed to assuming isothermal flow. The unstructured compressible algorithm in (Park & Mahesh, AIAA Paper 2007-0722) has been extended to solve for multiphase flows. A characteristic filter based shock capturing scheme, extended to handle non-ideal gases and mixtures, is applied in a predictor-corrector approach, ensuring that the shock-capturing is active only in the regions of discontinuity. A segregated implicit method is used to address the stiffness of the system. We discuss our numerical method, validation using benchmark problems and its application to study cavitation behind a circular cylinder for three different cavitation numbers $\sigma = 2.0$, 1.0 and 0.7.

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