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A Large Eddy Simulation Subgrid Model for Turbulent Phase Interface Dynamics

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Abstract

In this paper we report on the outline of a Large Eddy Simulation subgrid model for liquid/gas phase interface dynamics. A key feature of the proposed model is to take the subgrid phase interface dynamics fully into account by employing a dual-scale approach. Instead of modeling the LES subgrid phase interface geometry, we fully resolve it on an auxillary grid using the Refined Level Set Grid approach (Herrmann 2008). We then propose to model the LES subgrid velocity on the auxillary grid needed to move the fully resolved phase interface, by solving a dedicated PDE for its evolution near the phase interface. This PDE contains three different contributions. First, the subfilter turbulent eddies are taken into account by modeling the subfilter acceleration in lines of Oboukhovs log-normality conjecture on the stochastic field of ε. The second term, a velocity increment due to the relative motion between the two phases is modeled deriving renormalized velocity boundary condition at the phase interface. The final term, due to subfilter surface tension induced subfilter velocities is modeled following a Taylor analogy. Knowing the fully resolved phase interface geometry, all previously unclosed terms in the filtered Navier-Stokes equations can be directly closed using explicit filtering.

Key words: modeling; LES; subgrid model; subgrid surface tension; refined level set grid method

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