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Hybrid Large Eddy Simulation and Lagrangian Particle Simulation of Passive Scalar Mixing in a Supersonic Jet[1] YOUMING TAI, TOMOAKI WATANABE, KOJI NAGATA, Department of Aerospace Engineering, Nagoya University — Large eddy simulation combined with Lagrangian particle simulation (LES-LPS) is developed for predicting passive scalar mixing in supersonic turbulent flows. LPS solves a governing equation of passive scalar with notional particles, where the velocity of fluid particles is provided by LES while a molecular diffusion term is modeled by a mixing model. We propose a mixing volume model that computes the molecular diffusion term based on spatial averaging. In this model, the coarse-grained scalar dissipation rate is computed from a coarse-grained scalar gradient estimated from particles with an aid of a subgrid scale model of the scalar dissipation rate. The LES-LPS with the proposed mixing model is applied to a supersonic planar jet with passive scalar transfer. The LES-LPS is evaluated by comparing the results with direct numerical simulation (DNS) databases. In the present study, the number of mixing particles N_m is between 8 and 24. A mean scalar profile is well predicted by the LES-LPS for all of these parameters. However, root-mean-squared scalar fluctuations tend to increase with N_m. Comparisons of other statistics, such as probability density functions, confirm that the LES-LPS with $N_m \approx 12$ well predicts the passive scalar in the supersonic turbulent jet.

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