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Energy-Pressure-Velocity Filtered Mass Density Function MEHDI B. NIK, PEYMAN GIVI, University of Pittsburgh, CYRUS MADNIA, University at Buffalo (SUNY), STEPHEN B. POPE, Cornell University — A new methodology termed "energy-pressure-velocity filtered mass density function" (EPV-FMDF) is developed for large eddy simulation of high speed turbulent flows. This is an extension of the previously developed "velocity filtered density function" (V-FDF) method [1] in low speed flows. To account for the effect of compressibility, the formulation includes two additional thermodynamic variables: the pressure and the internal energy. This is the most general form of the FDF for high speed flow simulations. The EPV-FMDF is obtained by solving its transport equation, in which the effects of convection appear in a closed form. The unclosed terms are modeled in a fashion similar to that in RANS-PDF methods. The modeled EPV-FMDF transport equation is solved by a Lagrangian Monte Carlo method and is employed for LES of a temporally developing mixing layer at several values of the convective Mach number. The predicted results are assessed by comparison with direct numerical simulation (DNS) data.

[1] Gicquel, L. Y. M., Givi, P., Jaberi, F. A., and Pope, S. B., Velocity Filtered Density Function for Large Eddy Simulation of Turbulent Flows, Phys. Fluids, 14 (3):1196-1213 (2002).

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