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Variable Density Turbulence Spectra using the Sparse-Direct Interaction Perturbation[1] DAVID PETTY, CARLOS PANTANO, University of Illinois Urbana Champaign — Equations for the turbulence kinetic energy, velocity-scalar, and scalar power spectra have been derived for homogeneous isotropic variable-density turbulence. A perturbation about the incompressible limit is used to determine the leading order variable-density contribution to the two-point statistical quantities. Closure is achieved using the Sparse Direct-Interaction Perturbation (SDIP) technique. The resulting integro-differential equations are solved using a custom developed numerical method which leverages the Automatic Differentiation by OverLoading in C++ (ADOL-C) library. The numerical solutions indicate only minor changes to the velocity fields due to turbulence-scalar coupling. However, dilatation production is shown to generate turbulence scalar flux divergence even under statistically isotropic conditions. In addition, the scalar power spectrum can undergo anti-correlation under certain conditions. These model spectra are compared to those calculated from Direct Numerical Simulation of the same flow fields.

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