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An Analytical Model for the Three-Point Third-Order Velocity Correlation in Isotropic Turbulence[1] HENRY CHANG, ROBERT MOSER, University of Texas — In turbulent flows, the three-point third-order velocity correlation $T_{ijk}(\mathbf{r},\mathbf{r}') = \langle v_i(\mathbf{x})v_j(\mathbf{x}+\mathbf{r})v_k(\mathbf{x}+\mathbf{r}')\rangle$ is an important quantity. In particular, when considering large eddy simulation, the contribution of the nonlinear terms to evolution of the two-point second-order correlation of filtered velocities can be written in terms of integrals of the three-point correlation. In contrast, the two-point third order correlation appears in the equation for the unfiltered two-point correlation, and under the Kolmogorov scaling assumptions, this is sufficient to determine it. An analytic model for the three-point third-order correlation, under the same assumptions, would be very useful in the analysis of LES. There are constraints imposed by continuity and symmetry, and in 1954, Proudman and Reid determined a general form for the Fourier transform of this correlation that satisfies the constraints. Inverse transforming to physical-space yields a form for $T_{ijk}(\mathbf{r},\mathbf{r}')$ in terms of derivatives of a scalar function of the magnitudes of the separation vectors. Considering the simplest possible forms of the scalar function that are consistent with the known two-point third-order correlation in the Kolmogorov inertial range yields a six-dimensional space of representations. The coefficients of the representation for T_{ijk} are then determined from DNS data to yield the proposed model.

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