Pullin, D. I.; **Saffman, P. G.**

Reynolds stresses and one-dimensional spectra for a vortex model of homogeneous anisotropic turbulence. (English) Zbl 0830.76044

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Summary: Homogeneous anisotropic turbulence consisting of a collection of straight vortex structures is considered, each with a cylindrically unidirectional, but otherwise arbitrary, internal vorticity field. The orientations of the structures are given by a distribution P of appropriate Euler angles describing the transformation from laboratory to structure-fixed axes. One-dimensional spectra of the velocity components are calculated in terms of P, and the shell-summed energy spectrum. An exact kinematic relation is found in which volume-averaged Reynolds stresses are proportional to the turbulent kinetic energy of the vortex collection times a tensor moment of P. A class of large-eddy simulation models for nonhomogeneous turbulence is proposed based on application of the present results to the calculation of subgrid Reynolds stresses. These are illustrated by the development of a simplified model using a rapid-distortion-like approximation.

MSC:

76F99 Turbulence

Keywords:

straight vortex structures; Euler angles; shell-summed energy spectrum; turbulent kinetic energy; large-eddy simulation; rapid-distortion-like approximation

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