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Spatial-temporal spectra of velocity fluctuations in turbulent shear flows GUOWEI HE, TING WU, XIN ZHAO, LNM, Institute of Mechanics, Chinese Academy of Science — Space-time correlation or its Fourier form, spatial-temporal spectrum, is a minimal quantity to statistically characterize the temporal evolutions of spatial structures in turbulent flows. The Kraichnan-Tennekes random-sweeping model is well-known for spatial-temporal spectra in isotropic and homogeneous turbulence. Recently, Wilczek, Stevens and Meneveau (J. Fluid Mech. 2015 vol. 769, R1) have developed a simple model for spatial-temporal spectra in the Logarithmic layer of wall turbulence. In this study, we propose a model equation for turbulent shear flows. This model equation includes both sweeping and stretching effects and its solution gives an analytical expression for spatial-temporal spectra of stream-wise velocities. The results obtained are compared with the data from direct numerical simulation (DNS) of turbulent channel flows. It is found that this model is reasonably consistent with the DNS results for either small or large shear rates. This model is also discussed in comparison with the EA (elliptic approximation) model for space-time correlations in turbulent shear flows (Phys. Rev. E 79 046316 2009).

Guowei He
LNM, Institute of Mechanics, Chinese Academy of Science

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