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Structural features of the k_x^{-1} region of turbulent pipe flow at $\mathbf{Re}_\tau$ =3008[1] JUNSUN AHN, HYUNG JIN SUNG, KAIST — Structural features of a turbulent pipe flow were explored by using the direct numerical simulation data at Re_τ =3008 (Ahn et al. 2015). Based on the pre-multiplied streamwise energy spectra of the streamwise velocity fluctuations, three spectral regions were classified: the inner site, the outer site and k_x^{-1} region. The inner site was created by the self-sustaining near-wall cycle with $\lambda_x^+ \approx$1000, where λ_x is the streamwise wavelength. The outer site was made due to very-large-scale motions with $\lambda_x/\mathrm{R}\approx$10, which were generated by the streamwise pseudo-alignment of the adjacent large-scale motions. Between the inner and outer sites, the k_x^{-1} region appeared at y^+ =90-300, where $\lambda_x \geq 20y$ and $\lambda_x/\mathrm{R}\leq$5. By using the conditional averaging, self-similar structures of the streamwise velocity fluctuations structures in the k_x^{-1} region were retained, which were considered as the attached eddies proposed by Townsend (1976). In addition, the vortical structures in the k_x^{-1} region were examined by two-point correlation of the velocity components and the vortices in order to find the dominant behavior of the structures.

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