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Role of large-scale motions to turbulent inertia in turbulent pipe and channel flows[1] JINYUL HWANG, KAIST, JIN LEE, Johns Hopkins University, HYUNG JIN SUNG, KAIST — The role of large-scale motions (LSMs) to the turbulent inertia (TI) term (the wall-normal gradient of the Reynolds shear stress) is examined in turbulent pipe and channel flows at $Re_\tau \approx 930$. The TI term in the mean momentum equation represents the net force of inertia exerted by the Reynolds shear stress. Although the turbulence statistics characterizing the internal turbulent flows are similar close to the wall, the TI term differs in the logarithmic region due to the different characteristics of LSMs ($\lambda_x > 3\delta$). The contribution of the LSMs to the TI term and the Reynolds shear stress in the channel flow is larger than that in the pipe flow. The LSMs in the logarithmic region act like a mean momentum source (where TI >0) even the TI profile is negative above the peak of the Reynolds shear stress. The momentum sources carried by the LSMs are related to the low-speed regions elongated in the downstream, revealing that momentum source-like motions occur in the upstream position of the low-speed structure. The streamwise extent of this structure is relatively long in the channel flow, whereas the high-speed regions on the both sides of the low-speed region in the channel flow are shorter and weaker than those in the pipe flow.

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