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Statistics and large scales in turbulent pipe and channel flows[1]
JIN LEE, KAIST, JAE HWA LEE, Arizona State University, HYUNG JIN SUNG, KAIST — Turbulent pipe and channel flows have been generally accepted as having a similar turbulent flow structure. However, turbulence statistics in the core region of pipe flow are different from that of channel flow owing to the difference in the averaged spanwise dimension of the low-speed structures. In particular, wall-normal and spanwise stresses of channel flow are smaller than those of pipe flow. In the present study, DNS dataset of turbulent channel and pipe flows with the friction Reynolds number Re=934 have been compared to elucidate the difference of statistics in terms of the populations of large and very-large scales in the low-speed region. To this end, large and very-large scales were extracted by a low-pass filtered streak detection algorithm. We found that the population density of large scales of pipe flow is more increased in the core region than that of channel flow. Although the density of very-large scales of pipe flow decreases, the area of low-speed region increases due to the large number of large scales. Further comparison of pipe and channel flows showed that the higher turbulence intensity of pipe flow is caused by the interference of large scales with the azimuthal distance.

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