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Drag reduction in plane Couette flow of dilute polymer solutions[1]
NANSHENG LIU, HAO TENG, XIYUN LU, University of Science and Technology of China, BAMIN KHOMAMI, University of Tennessee, Knoxville, — Drag reduction (DR) in the plane Couette flow (PCF) by the addition of flexible polymers has been studied by direct numerical simulation (DNS) in this work. Special interest has been directed to explore the similarity and difference in the DR features between the PCF and the plane Poiseuille flow (PPF), and to clarify the effects of large-scale structures (LSSs) on the near-wall turbulence. It has been demonstrated that in the near-wall region the drag-reduced PCF shares typical DR features similar to those reported for the drag-reduced PPF (White Mungal 2008; Graham 2014), however in the core region intriguing differences are found between these two DR shear flows of polymeric solution. Specifically, in the core region of the drag-reduced PCF, the polymer chains are stretched substantial and absorb kinetic energy from the turbulent fluctuations. In commensurate, peak values of conformation tensor components C_{yy} and C_{zz} occur in the core region. This finding is strikingly different from that of the drag-reduced PPF. For the drag-reduced PCF, the LSSs are found to have monotonically increasing effects on the near-wall flow as the Weissenberg number increases, and have their spanwise length scale unchanged.

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Nansheng Liu
University of Science and Technology of China

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