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Direct Numerical Simulation of Turbulent Taylor-Couette Flow at High Reynolds Number

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Taylor-Couette flow is of great importance in a wide range of engineering applications, such as rotating machineries and reactors. In this study, we focus on turbulent Taylor-Couette flow with a fixed outer cylinder and a rotating inner cylinder. Direct numerical simulation (DNS) of turbulent Taylor-Couette flow has been conducted to investigate turbulent characteristics at high Reynolds number over Re = 10000. Reynolds number, Re, is defined by gap width and rotating speed of inner cylinder. Turbulent characteristics are expected to change around Re=10000, referring to Wendt's empirical formula. The strength and position of Taylor vortices is fluctuated temporally and spatially in this range of Reynolds number. As a result, the interactions between Taylor vortices and fine-scale eddies become complicated. Finally, turbulent statistics including Reynolds stress budgets are investigated to reveal turbulent characteristics at high Reynolds number in detail.

Keywords: Turbulent Taylor-Couette Flow, Direct Numerical Simulation, Reynolds Number Effects, Taylor Vortices, Fine-Scale Eddies