Turbulent pipe flows subjected to temporal decelerations\(^1\) WONG-WAN JEONG, HYUNGJAE LIM, JAE HWA LEE, Ulsan Natl Inst of Sci Tech — Direct numerical simulations of temporally decelerating turbulent pipe flows were performed to examine effects of temporal decelerations on turbulence. The simulations were started with a fully developed turbulent pipe flow at a Reynolds number, \(Re_D=24380\), based on the pipe radius \((R)\) and the laminar centerline velocity \((U_c)\). Three different temporal decelerations were imposed to the initial flow with \(f=\frac{dU_b}{dt}=0.00127, 0.00625, \) and \(0.025\), where \(U_b\) is the bulk mean velocity. Comparison of Reynolds stresses and turbulent production terms with those for steady flow at a similar Reynolds number showed that turbulence is highly intensified with increasing \(f\) due to delay effects. Furthermore, inspection of the Reynolds shear stress profiles showed that strong second- and fourth-quadrant Reynolds shear stresses are greatly increased, while first- and third-quadrant components are also increased. Decomposition of streamwise Reynolds normal stress with streamwise cutoff wavelength \((\lambda_x)\) \(1R\) revealed that the turbulence delay is dominantly originated from delay of strong large-scale turbulent structures in the outer layer, although small-scale motions throughout the wall layer adjusted more rapidly to the temporal decelerations.

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