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Grid generated turbulence in the near-field RICARDO SALAZAR, JUAN ISAZA, Universidad EAFIT, ZELLMAN WARHAFT, Cornell University —
Using a conventional bi-planar turbulence-generating grid, we confirm the recent findings (Valente & Vassilicos, Phys. Rev. Lett., vol. 108, 2012, art. 214503) that show there is a turbulence decay region close to the generating grid that departs from the "classical" turbulence decay (Comte-Bellot & Corrsin, J. Fluid Mech., vol. 25, 1966, pp. 657–682). In this "near field" region, the turbulence energy decays more rapidly than in the far field and it exhibits unusual scaling properties. Based on the velocity decay laws, we show that for our conventional grid, the near field extends from x/M $\sim$ 6 to x/M $\sim$ 12 where x is the downstream distance from the grid and M is the mesh size. However, other statistics (velocity derivatives and length scales ratios) indicate that the extent of the initial period depends on the grid mesh Reynolds number, R_M, extending further for higher values of R_M. In the near field the turbulence approaches isotropy both at the large and small scales but there still is inhomogeneity in the derivative statistics. The derivative skewness also departs from values observed at comparable Reynolds numbers in the far field decay region, and in other turbulent flows at comparable Reynolds numbers. We do not believe that the near field scaling violates Kolmogorov phenomenology, which applies to systems that are not affected by proximity to initial and boundary conditions. These conditions are not met close to the grid.

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