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Normalizations of High Taylor Reynolds Number Power Spectra[1]

ALEJANDRO PUGA, TIMOTHY KOSTER, JOHN C. LARUE, University of California, Irvine — The velocity power spectrum provides insight in how the turbulent kinetic energy is transferred from larger to smaller scales. Wind tunnel experiments are conducted where high intensity turbulence is generated by means of an active turbulence grid modeled after Makita's 1991 design (Makita, 1991) as implemented by Mydlarski and Warhaft (M&W, 1998). The goal of this study is to document the evolution of the scaling region and assess the relative collapse of several proposed normalizations over a range of R_λ from 185 to 997. As predicted by Kolmogorov (1963), an asymptotic approach of the slope (n) of the inertial subrange to $-5/3$ with increasing R_λ is observed. There are three velocity power spectrum normalizations as presented by Kolmogorov (1963), Von Karman and Howarth (1938) and George (1992). Results show that the Von Karman and Howarth normalization does not collapse the velocity power spectrum as well as the Kolmogorov and George normalizations. The Kolmogorov normalization does a good job of collapsing the velocity power spectrum in the normalized high wavenumber range of $0.0002 \leq \kappa\lambda \leq 0.4$ while the George normalization does a better job in the normalized mid-wavenumber range of $15 \leq \kappa\lambda \leq 25$.

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