Respective effects of large-scale intermittency and mean-velocity gradient on turbulent scaling-range exponents in a square jet

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Extended Abstract

Large-scale intermittency factor (γ), mean shear rate (S) and Reynolds number (Re) are found to have significant influences on the scaling-range exponents (the exponents of the power law exhibited by the spectrum in the inertial sub-range) by previous studies, such as Mi and Antonia [*Phys. Rev. E* 2001 **64** 026302]. Yet, the respective effects of these factors remain unclear. The present study is to address this issue, i.e., to investigate the effects of γ, S^* and Re in a turbulent square jet by experiment using hot-wire anemometry.

The respective effects of the intermittency factor and mean shear rate can be approximately separated in cases corresponding to different flow regions of a jet. As shown in Figure 1, γ is almost stable while S rapidly changes for $y/y_{1/2} < 1.0$ (where y is the distance from the axis and $y_{1/2}$ is the half width of the jet), and vise versa for $y/y_{1/2} > 1.0$. Thus, the respective effects of γ and S on the scaling-range exponents may be studied individually in the two y-ranges.

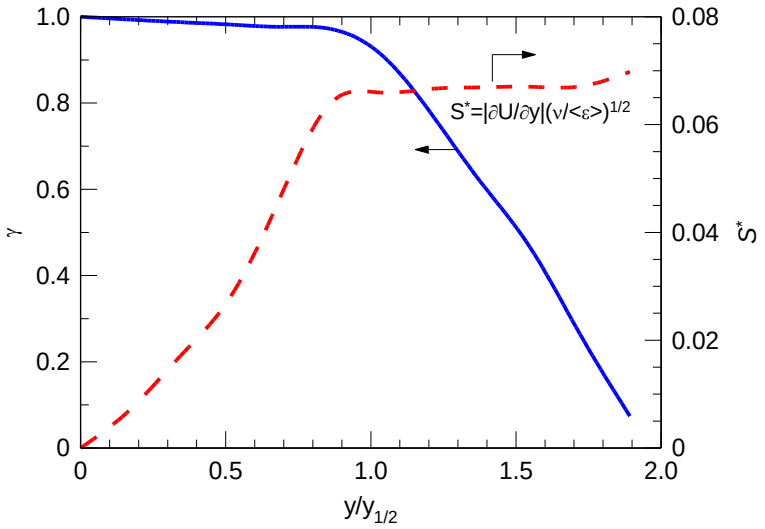

Figure 1. Lateral distributions of the intermittency γ and the nondimensional mean shear rate S^*.

Figure 2 shows the combined effect of the Reynolds number and space locations. Clearly, the exponent m grows as y increases but the growth rate is smaller at $y/y_{1/2} <$

1.0 than $y/y_{1/2} > 1.0$. This suggests that the energy transfer and dissipation are more rapid in the outer range of the jet than in the inner range. As *Re* is increased, the lateral growth rate of *m* decreases. This observation suggests that, as *Re* increases, the far-field turbulence of the square jet tends to be less anisotropic.

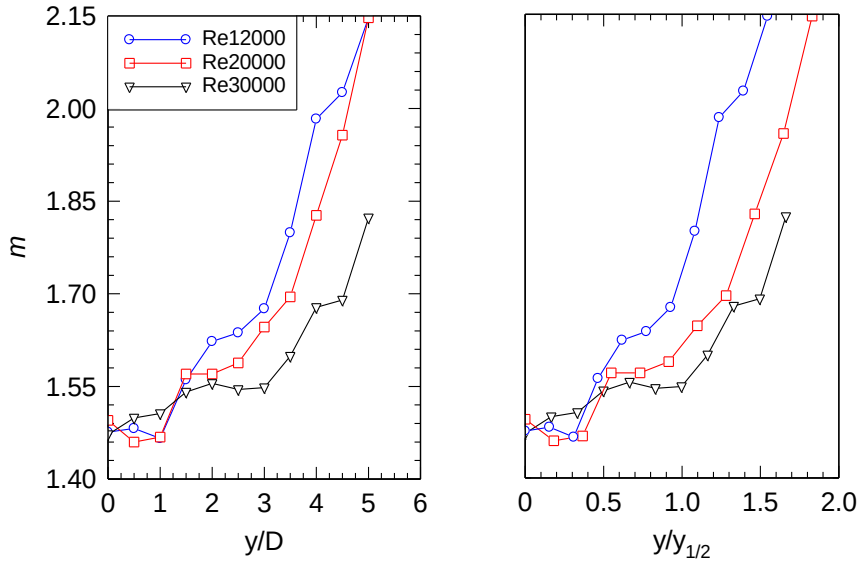

Figure 2. Combined effect of Reynolds number and lateral location.

The final paper will present detailed results of the respective influences of γ, S^* and *Re* on the scaling-range exponents which may inspire more physical insight and fundamental understanding of jet.

Key Words: intermittency; mean shear; scaling-range exponents; turbulent square jet