

Abstract Submitted  
for the DFD13 Meeting of  
The American Physical Society

**Detrended Structure-Function in Fully Developed Turbulence<sup>1</sup>**

YONGXIANG HUANG, Shanghai Institute of Applied Mathematics and Mechanics, Shanghai University, Shanghai 200072 China — A detrended structure-function (DSF) method is proposed to extract scaling exponent by constraining the influence of large-scale structures. This is accomplished by removing a  $q$ th-order polynomial fitting within a window size  $\tau$  before calculating the velocity increment. By doing so, the scale larger than  $\tau$ , i.e.,  $r \geq \tau$ , is expected to be removed. The detrending process is equivalent to a high-pass filter. We first validate the DSF by using synthesized fractional Brownian motion for mono-fractal process and lognormal process for multifractal random walk process. When applying the DSF to a turbulent velocity obtained from a high Reynolds number wind tunnel experiment with  $Re_\lambda \simeq 720$ , the third-order DSF demonstrates a clear inertial range with  $\mathcal{B}_3(\tau) \sim \tau$  on the range  $0.001 < \tau < 0.1$  sec, corresponding to a frequency range  $10 < f < 1000$  Hz, which is the inertial range predicted by using the Fourier power spectrum. The directly estimated scaling exponents (resp. singularity spectrum  $f(\alpha)$ ) agree very well with the lognormal mode with an intermittent parameter  $\mu = 0.33$ . Due to large-scale effects, the scaling exponents and singularity spectra provided by both the SFs and DFAs are biased.

<sup>1</sup>This work is sponsored by the National Natural Science Foundation of China under Grant (No. 11072139, 11032007, 11222222, 11272196 and 11202122), “Pu Jiang” project of Shanghai (No. 12PJ1403500).

Yongxiang Huang  
Shanghai Institute of Applied Mathematics and Mechanics,  
Shanghai University, Shanghai 200072 China

Date submitted: 11 Jun 2013

Electronic form version 1.4