

# Spanwise coherent structure of wind turbulence and induced pressure on rectangular cylinders

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**Abstract:** Studying the spatial distribution in coherent fields such as turbulence and turbulence-induced force is important to model and evaluate turbulence-induced forces and response of structures in the turbulent flows. Turbulence field-based coherence function is commonly used for the spatial distribution characteristic of the turbulence-induced forces in the frequency domain so far. This paper will focus to study spectral coherent structure of the turbulence and induced forces in not only the frequency domain using conventional Fourier transform-based coherence, but also temporo-spectral coherence one in the time-frequency plane thanks to wavelet transform-based coherence for better understanding of the turbulence and force coherences and their spatial distributions. Effects of spanwise separations, bluff body flow, flow conditions and Kamian vortex on coherent structures of the turbulence and induced pressure, comparison between turbulence and pressure coherences as well as intermittency of the coherent structure in the time-frequency plane will be investigated here. Some new findings are that not only the force coherence is higher than the turbulence coherence, the coherences of turbulence and forces depend on the spanwise separation as previous studies, but also the coherent structures of turbulence and forces relate to the ongoing turbulence flow and bluff body flow, moreover, intermittency in the time domain and low spectral band is considered as the nature of the coherent structure. Simultaneous measurements of the surface pressure and turbulence have been carried out on some typical rectangular cylinders with slenderness ratios  $B/D=1$  (without and with splitter plate) and  $B/D=5$  under the artificial turbulent flows in the wind tunnel.

**Author Keywords:** Coherent structure; Continuous wavelet transform; Spanwise coherence; Surface pressure; Time-frequency analysis; Wavelet coherence; Wind turbulence

**Index Keywords:** Bluff body flows; Coherence function; Coherent fields; Coherent structure; Continuous Wavelet Transform; Flow condition; Frequency domains; Intermittency; Rectangular cylinder; Simultaneous measurement; Slenderness ratios; Spatial distribution; Spectral band; Spectral coherence; Splitter plates; Surface pressures; Time domain; Time-frequency planes; Turbulence fields; Turbulence flow; Wind turbulence; Coherent light; Cylinders (shapes); Fourier transforms; Frequency domain analysis; Size distribution; Time domain analysis; Turbulent flow; Wavelet transforms; Turbulence

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