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How to derive time-varying mean from non-stationary wind

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ABSTRACT

How to derive the meaningful time-varying mean from the time series is difficult and also relies on the researcher's judgment (Chen and Letchford 2004; Xu and Chen 2004; Huang and Chen 2009; Wang et al. 2013). In this paper, the application of the discrete wavelet transform (DWT), ensemble empirical mode decomposition (EEMD) and kernel regression (KR) to extract the time-varying mean from non-stationary winds is discussed. The time histories of the typhoon Dujuan and rear-flank downburst (RFD) wind speeds are investigated as examples, respectively. Intervals sizes of 1h, 10min, and 1min are selected for Typhoon Dujuan data and intervals sizes of 5, 2, and 1min are selected for the RFD data to obtain three different mean results, respectively. A higher and a lower Daubechies wavelet orders are also compared. Clearly, these selected intervals satisfy the criteria that the highest frequency embedded in the time-varying mean is much lower than the first structural frequency.

In order to determine the more meaningful mean, the remaining nonstationary fluctuation should also be reasonable, that is, the estimated evolutionary spectra (ES) have more physical meaning. In this study, the estimated ESs will be evaluated. Furthermore, the dynamic response of a tall building subjected to the non-stationary wind is considered to assess the meaningful derivation of the time-varying mean and fluctuation. The results show that DWT and EEMD can provide the more satisfactory mean extraction than KR, and Daubechies wavelet with a higher order would obtain much better results.

REFERENCES

Chen, L. and Letchford, C.W. (2004). "A deterministic-stochastic hybrid model of downbursts and its impact on a cantilevered structure", Eng Struct., 26, 619-629.
Huang, G and Chen, X (2009) "Wavelets-Based Estimation of Multivariate Evolutionary Spectra and Its Application to Nonstationary Downburst Winds." Eng. Struct., 31(4), 976-989.
Wang, L., McCullough, M. and Kareem, A. (2013). "A data-driven approach for simulation of full-scale downburst wind speeds", J. Wind Eng. Ind. Aerodyn., 123,171-190.
Xu, Y.L. and Chen, J. (2004), "Characterizing non-stationary wind speed using empirical mode decomposition", J. Struct. Eng., ASCE, 130, 912-920.

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