An Approach For Parametric Identification Of Vortex-Excited Force Using On-Site Measured Vibration Data On A Long-Span Bridge

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In recent years, vortex-induced vibration (VIV) events had occurred on several long-span suspension bridges around the world. Normally, VIV of the long-span bridge is investigated in wind tunnel tests or computational fluid dynamics. However, examination of bridge VIV through full-scale field test data has rarely been conducted since its rare occurring frequency. Because of the fast development of high precision sensors and high-frequency data transmission devices, identification of structural modal information utilizing field test data from structural health monitoring systems is emerging as a powerful tool to explore the structural dynamic status and locate potential damages. Therefore, it is possible and necessary to inspect the bridge VEF (vortex-excited force) parameters from full-scale field test data and then to simulate and estimate structural VIV response based on VEF parameters. Existing VEF parametric identification techniques allow structures (sectional model or full-scale bridges) to be tested under laminar flow in wind tunnel test with known dynamic properties (inertial frequency and damping ratio) and it requires measuring responsive signal and VEF signal synchronously. However, for the actual field test of the full-scale bridge, the flow field is turbulent, and the structural responsive signal is unavoidably contaminated by measuring noises. Furthermore, it is impractical to synchronously record the aerodynamic force applied on the bridge deck on the field test. In this study, a Bayesian inference approach is introduced for the identification of VEF parameters using the field vibration data. Using the fast Fourier transform (FFT) of field vibration data, a frequency domain formulation is proposed focusing on structural vibration mode excited during VIV events. This method fully considers the influence of random vibration induced by ambient excitation and instrument measurement error on the field vibration data, and only the responsive data is needed without measuring the aerodynamic force information.