Mode shape reconstruction of an impulse excited structure using continuous scanning laser Doppler vibrometer and empirical mode decomposition

Abstract

For vibration testing, discrete types of scanning laser Doppler vibrometer (SLDV) have been developed and have proven to be very useful. For complex structures, however, SLDV takes considerable time to scan the surface of structures and require large amounts of data storage. To overcome these problems, a continuous scan was introduced as an alternative. In this continuous method, the Chebyshev demodulation (or polynomial) technique and the Hilbert transform approach have been used for mode shape reconstruction with harmonic excitation. As an alternative, in this paper, the Hilbert-Huang transform approach is applied to impact excitation cases in terms of a numerical approach, where the vibration of the tested structure is modeled using impulse response functions. In order to verify this technique, a clamped-clamped beam was chosen as the test rig in the numerical simulation and real experiment. This paper shows that with additional innovative steps of using ideal bandpass filters and nodal point determination in the postprocessing, the Hilbert-Huang transformation can be used to create a better mode shape reconstruction even in the impact excitation case.