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Hilbert Transform and its Applications in System Identification

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ABSTRACT
Vibration-based techniques for system identification and damage detection have been investigated for many applications in civil infrastructure. Although difficult to shed light on structural damage over a long period of time due to environmental factors and potentially missing archival data, the change in vibration characteristics in a short time can be closely related to the dynamic properties and cracks of an engineered structure. In this presentation, Hilbert Transform is applied for signal/mode decomposition, system identification, and damage detection of buildings. First, fundamentals of Hilbert transform will be briefly reviewed. A Hilbert transform based signal decomposition theory will then be presented for both stationary and non-stationary signals. Its equivalency with an adaptive filter will be discussed and compared with conventional rectangular filters in terms of "rigid wall" effects at the cutoff frequencies of a finite length signal. Finally, the new theory will be applied to analytically decompose the vibration modes of structural systems and thus identify the properties of a linear or weakly nonlinear structure based on numerical or experimental simulations. This presentation will conclude with a summary of advantages and disadvantages of using Hilbert Transform in system identification in comparison with several commonly used techniques.

KEYWORDS: *Hilbert Transform, System Identification, Analytic Function, Mode Decomposition*