International Journal of Innovative
Computing, Information and Control
Volume **6**, Number **3(A)**, March **2010**

ICIC International ©2010 ISSN 1349-4198
pp. 1123–1131

A FULL-HEIGHT DAMAGE IDENTIFICATION METHOD OF TOWER STRUCTURAL BY ELIMINATING GIBBS PHENOMENON

Baifeng Gao, Huijian Li and Yanxia Liu

School of Civil Engineering and Mechanics
Yanshan University
Qinhuangdao, 066004, P. R. China
gbf88@263.net; { ysulhj; ysulyx }@163.com

Received September 2008; revised February 2009

Abstract. *This paper proposes a damage identification approach for tower structures based on the dynamic response information expansion. This approach is to identify damage positions of the tower structure by adopting wavelet transformation, which requires dynamic response information. However, it is noted that Gibbs phenomenon causes signal singularity at the end of identification range and resists the damage identification on the boundary and in the symmetry area of structures. In this paper, the damage identification region of a tower structure is expanded to full structure height based on the effective continuation of dynamic response information, especially in the top and bottom of a tower, by eliminating Gibbs phenomenon. The analysis results obtained show that this approach is effective and reliable to structure damage identification.*
Keywords: Damage identification, Tower structure, Wavelet transformation, Gibbs phenomenon, Information expansion

1. **Introduction.** The damage evaluation of modern engineering structures is extremely important due to the large scale and complexity of these structures. Under the environmental load and erosion, natural disasters and so on, the damages, e.g., normal displacement, distortion, cracking, and material breakage and deterioration, may appear in the structure, and they would grow rapidly. If these damages were not found in time, their accumulation and propagation would lead to the catastrophic rupture of whole structure and cause an immeasurable loss. Therefore, the structure damage identification becomes a very active research field in the structural engineering and the effective identification is of realistic significance for health diagnosis and reinforcing reconstruction of structures [1]. With regard to this, numerous researchers pay close attention to theoretical investigations and applications on various structural damage identification parameters, such as strain energy [2], Ritz vector [3], nature frequency measurement [4], incurvature mode shapes [5], modal analysis [6], flexibility [7], and some other composite approaches, e.g., APC and DSM approaches [8]. The traditional signal processing mainly adopts spectroscopy analysis method based on Fourier transform. This pure frequency-domain analysis has its advantages in analyzing the average signal. But, it cannot be used to describe local transient features of signal and has no time domain resolution capacity. So, many other methods, e.g., wavelet analysis, etc., have been used for signal detection and identification [9-11]. Using wavelet transform in identifying structure modal parameters can overcome these shortcomings, and accurately identify early occurred structural damage [12-13]. However, it is unfortunate that it will be difficult to make an accurate judgment with these methods if structural damages occur on the boundary and in the symmetry