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Algorithmic and Computing Technologies for Health Assessment of Real Structures in the Presence of Nonlinearity and Uncertainty

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ABSTRACT

The research team at the University of Arizona proposed several novel structural health assessment (SHA) algorithms. Structures are represented by finite elements (FE) and the health is assessed by identifying the stiffness parameters of all the elements and comparing them with expected values, or with previous values, or observing differences between similar elements. They can identify the location and severity of defect and exact location within a defective element. These algorithms use several system identification (SI) based concepts with different levels of sophistications. They do not require excitation information and can assess the health of large structural systems using only limited noise-contaminated acceleration time-histories measured at a small part of a structure. They are widely available in the literature. However, algorithmic and computational rigors of them are generally not presented in technical papers due to severe page limitation. Some of them are briefly presented in this paper without discussing the specific algorithms.

INTRODUCTION

Health assessment and monitoring (HAM) of infrastructures has become one of the important research areas. Globally an estimate of 2% of gross domestic product (GDP), about U.S. $960 billion, is spent annually on infrastructure investment and maintenance. Based on the Report Card of 2005 for Americas Infrastructure, it was estimated that over $1.6 trillion over a five-year period was necessary to bring the nation's infrastructure to a good condition.

This enormous challenge has attracted multidisciplinary research interest. One line of approach has been to extend the life of infrastructures by locating defects and evaluating their severity at the local element level and taking the appropriate remedial actions without exposing public to out-of-ordinary risk. The authors have been