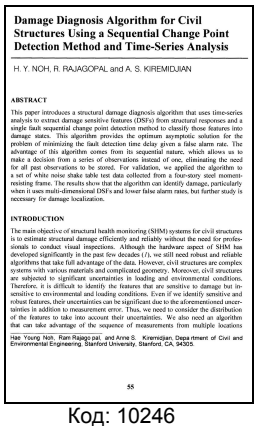
Damage Diagnosis Algorithm for Civil Structures Using a Sequential Change Point Detection Method and Time-Series Analysis

H. Y. NOH, R. RAJAGOPAL and A. S. KIREMIDJIAN

ABSTRACT

This paper introduces a structural damage diagnosis algorithm that uses time-series analysis to extract damage sensitive features (DSFs) from structural responses and a single fault sequential change point detection method to classify those features into damage states. This algorithm provides the optimum asymptotic solution for the problem of minimizing the fault detection time delay given a false alarm rate. The advantage of this algorithm comes from its sequential nature, which allows us to make a decision from a series of observations instead of one, eliminating the need for all past observations to be stored. For validation, we applied the algorithm to a set of white noise shake table test data collected from a four-story steel moment-resisting frame. The results show that the algorithm can identify damage, particularly when it uses multi-dimensional DSFs and lower false alarm rates, but further study is necessary for damage localization.

INTRODUCTION

The main objective of structural health monitoring (SHM) systems for civil structures is to estimate structural damage efficiently and reliably without the need for professionals to conduct visual inspections. Although the hardware aspect of SHM has developed significantly in the past few decades (1), we still need robust and reliable algorithms that take full advantage of the data. However, civil structures are complex systems with various materials and complicated geometry. Moreover, civil structures are subjected to significant uncertainties in loading and environmental conditions. Therefore, it is difficult to identify the features that are sensitive to damage but insensitive to environmental and loading conditions. Even if we identify sensitive and robust features, their uncertainties can be significant due to the aforementioned uncertainties in addition to measurement error. Thus, we need to consider the distribution of the features to take into account their uncertainties. We also need an algorithm that can take advantage of the sequence of measurements from multiple locations

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Ключевые слова:

Содержание.