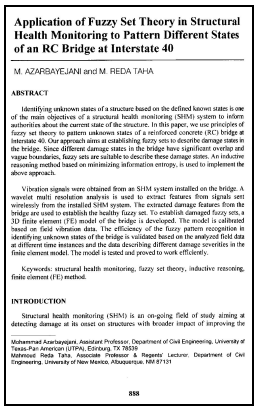

Application of Fuzzy Set Theory in Structural Health Monitoring to Pattern Different States of an RC Bridge at Interstate 40

M. AZARBAYEJANI and M. REDA TAHA

ABSTRACT

Identifying unknown states of a structure based on the defined known states is one of the main objectives of a structural health monitoring (SHM) system to inform authorities about the current state of the structure. In this paper, we use principles of fuzzy set theory to pattern unknown states of a reinforced concrete (RC) bridge at Interstate 40. Our approach aims at establishing fuzzy sets to describe damage states in the bridge. Since different damage states in the bridge have significant overlap and vague boundaries, fuzzy sets are suitable to describe these damage states. An inductive reasoning method based on minimizing information entropy, is used to implement the above approach.

Vibration signals were obtained from an SHM system installed on the bridge. A wavelet multi resolution analysis is used to extract features from signals sent wirelessly from the installed SHM system. The extracted damage features from the bridge are used to establish the healthy fuzzy set. To establish damaged fuzzy sets, a 3D finite element (FE) model of the bridge is developed. The model is calibrated based on field vibration data. The efficiency of the fuzzy pattern recognition in identifying unknown states of the bridge is validated based on the analyzed field data at different time instances and the data describing different damage severities in the finite element model. The model is tested and proved to work efficiently.

Keywords: structural health monitoring, fuzzy set theory, inductive reasoning, finite element (FE) method.

INTRODUCTION

Structural health monitoring (SHM) is an on-going field of study aiming at detecting damage at its onset on structures with broader impact of improving the

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Ключевые слова:
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Содержание.