Engineering Structures, vol.207, no.110234, pp.110234-1-110234-15, March, 2020.

# Civil structure condition assessment by a two-stage FE model update based on neural network enhanced power mode shapes and an adaptive roaming damage method

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**Abstract-**

**Vibration-based damage identification of large and complex structures requires a huge computational effort to solve an ill-posed inverse problem with a large number of unknowns. Moreover, due to the limited number of measurement sensors, the capability to detect damage is quite limited. To mitigate these disadvantages, a two-stage model updating method based on the proposed novel localised damage function approach called roaming damage method (RDM) is proposed. The roaming damage method has the ability to identify a wide range of damage types, from large areas of low damage to individual beams which have been severely damaged. The approach can be applied to complex and refined 3D finite element models in only two steps. To enhance identification, the optimization procedure is formulated in a multi-objective context dependent on a spectrum-driven feature that is based on the Power Mode Shapes (PMS) from measured responses. Unlike conventional mode shapes, PMSs contain information from the entire frequency range. The well-known case study of the I-40 bridge in New Mexico is chosen to apply and further investigate this technique with the aim of testing its reliability. The simulated dynamic data obtained from random vibrations are employed to evaluate the performance of the method. Two additional features to improve the proposal, the ANN enhanced PMS RMD and RDM with adaptive radius, have also been explored.**

**Index Terms- Multistage damage identification; Roaming damage method; Power mode shapes; Neural networks; Large structures; Adaptive method**



**Citation:**

*Perera, R.; Sandercock, S.; Carnicero, A. "Civil structure condition assessment by a two-stage FE model update based on neural network enhanced power mode shapes and an adaptive roaming damage method", Engineering Structures, vol.207, no.110234, pp.110234-1-110234-15, March, 2020.*