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CRACK DAMAGE DETECTION IN BEAM-LIKE STRUCTURES USING RBF NEURAL NETWORKS WITH EXPERIMENTAL VALIDATION

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Abstract. *A crack damage detection algorithm is presented using a combination of global (changes in natural frequencies) and local (strain mode shapes) vibration-based analysis data as input in artificial neural networks (ANNs) for location and severity prediction of crack damage in beam-like structures. Finite element analysis has been used to obtain the dynamic characteristics of intact and damaged cantilever steel beams for the first three natural modes. Different damage scenarios have been introduced assumptiving the crack is located at different locations along the length of beam finite element model (FEM). The necessary features for crack detection have been selected and introduced to the ANNs. In the experimental analysis, several steel beams with six distributed surface-bonded electrical strain gauges and an accelerometer mounted at the tip have been used to obtain modal parameters such as resonant frequencies and strain mode shapes. Finally, the Radial Basis Function ANNs have been trained using the data obtained from the numerical damage case to predicate the severity and localization of the crack damage.*
Keywords: Crack damage, Strain mode shape, Finite element model, RBF neural networks

1. **Introduction.** Civil engineering structures are prone to damage and deterioration during their service life. Damage assessment attempts to determine whether structural damage has occurred, as well as the location and extent of any such damage. Non-destructive inspection techniques are generally used to investigate the critical changes in the structural parameters so that an unexpected failure can be prevented. These methods concentrate on a part of the structure and in order to perform the inspection, the structure needs to be taken out of ser- vice. These damage identification techniques in a large complex structure are challenging tasks for the in situ measured data of large civil engineering structures such as bridges and buildings. Further more, they are inaccurate (owing to noise or disruption) and often incomplete (for economic consideration). On the other hand, damage can be detected, quantified and localized by on-line damage assessment techniques using vibration-based analysis data in the service life of a structure. The effects of common damage on a structure are changes in natural frequencies, mode shapes and structural damping. Since the measurement of natural frequencies is easier than that of changes in structural damping, damage can be detected from dynamic analysis using natural frequencies and mode shapes.