Abstract

Damage detection and rehabiltation is one of the most economical methods of increasing safety and service life of the structures. In this research, a wave-based methodology is introduced for laminar damage location in single axial members and combined axial-flexural members within a structure. Laminar damage is a kind of local damage in which the cross section area of a member decreases within a specific length.

In the proposed wave-based methodology, a structure with a laminar damage is analyzed using a Finite Element (FE) software under a high frequency loading, and the strain values in specific points of the structure is collected. Thereafter, using the wave propagation theories and the strain values in various points, the location and extent of the damage within the structure is specified by introducing a Total Convergence Index (*TCI*). *This index* is calculated based on spectral analysis and a try-and-error optimization scheme is utilized for minimizing its calculation process.. To make the optimization process more efficient, Particle Swarm Optimization (PSO) method is also used for mitigating the computational cost. It is observed that the PSO method can reduce the TCI calculation process as much as 98 percent.

In the last part of the research, a probabilistic approach is utilized for considering the noise sensivity of the proposed approach. The results show that this method has a low sensitivity to the noise and it can be easily utilized for the damage detection in the noisy environments.

Key words: Damage detection, Laminar damage, Strain, Wave propagation, Total convergence index, Optimization, Probabilistic approach