Effects and optimization of the Particle Swarm Optimization parameters for structural dynamic monitoring of cantilever beam

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Abstract

Nowadays, Particle swarm optimization (PSO) has become a widespread optimization method [1]. However, it is well known that its main parameters (the inertia weight, the two learning factors, the velocity constraint and the population size) have a critical effect on the performances [2,3]. Currently there is still no comprehensive analysis of these parameter selection, especially for solving damage detection problems [4]. Hence, this paper investigates the effects of the PSO parameters for structural dynamic monitoring of the beam structure. First, the effects of the parameters on the performance of the algorithm are studied by simulating damage detection of the beam structure. Then, considering the parameter selection problem as a classical optimization problem, an optimization method is used to determine the best parameter configuration, without any expert experience. Due to the complex interactions between some parameters, it is difficult to find the best combination by relying on single parameter analysis. As a consequence, each parameter configuration is considered as a parameter tuple, and the goal of the optimization algorithm is to find the best tuple. Finally, for the assessment and demonstration of the proposed method, some numerical simulations are achieved in order to detect single and multiple damages in a cantilever beam. The paper systematically investigates the effects of the parameters of the standard PSO for the damage detection problem. The characteristics of the parameters are described as well, and a guideline for determining them is provided.

Keywords: Particle Swarm Optimization, Parameter Selection, Structural Damage Detection, Cantilever Beam.

References

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