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Self-adaptive parallel genetic algorithm for rapid parameter identification of Bouc–Wen model for self-centering shear walls

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ABSTRACT

An effective rapid performance evaluation technique for structures is essential for disaster reduction, while it is difficult particularly for complex hysteretic structures. The Bouc-Wen-Baber-Noori model applied in this research is a versatile smooth hysteretic model that describes the features of stiffness degradation, strength degradation and pinching effect. However, the identification of the model parameters is difficult owing to the lack of an effective identification algorithm for structures with complex hysteretic characteristic. To obtain the hysteretic parameters of the characteristic of self-centering shear walls efficiently, a metaheuristic optimization algorithm called the self-adaptive parallel genetic algorithm (SPGA) was developed. The cyclic experiment results of seven self-centering shear walls characterized by a very small residual deformation, were used for parameter identification. This study focused on the problems of identification accuracy and efficiency by improving the genetic operators, optimizing the genetic strategies, and concerning about the searching stability, local convergence, and time consumption in high-dimensional and large-scale optimization spaces. The feasibility and superiority of the SPGA were verified by comparing the hysteretic characteristic, lateral forces and stiffness degradation curve obtained by SPGA with those by the standard genetic algorithm (SGA) and by experimental data. A comparison of the convergence, fluctuation, and time consumption between the SPGA and SGA also demonstrates the advantages of the optimized algorithm.

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