A Chaos Game Optimization Method for Weight Minimization of Steel Truss Structures

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Abstract

The paper proposes the so-called chaos game optimization (CGO) method to perform the optimal sizing design of steel truss structures under applied loading regimes. The optimization problem aims at the minimization of the total weight (directly related to the cost function) of the designed structure subjected to the constraints describing the intrinsic structural responses complying with limit-state specifications. The CGO approach is based on the underlying chaos theory that establishes the primary patterns as fractals in responses to the systems representing them as self-organized dynamical systems. The fractal is generated as an initial Sierpinski triangle (i.e., search space of solution candidates) with randomly selected initial points to map out the sequence of points and hence the overall shape of the triangle. The optimal solutions can be obtained at a small amount of searching efforts. The applications in the optimal sizing design of steel trusses under specified forces illustrate the efficiency and accuracy of the CGO method through the good comparisons with some available benchmarks (including the statistical data of solutions) solved by other meta-heuristic techniques.

Keywords: Chaos Game Optimization; Meta-Heuristic Algorithm; Optimal Sizing Design; Steel Trusses; Sierpinski Triangle.