An enhanced approach for optimizing mathematical and structural problems by combining PSO, GSA and gradient directions

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Abstract

In this paper, the combination of particle swarm optimization (PSO) and gravitational search algorithm (GSA) is enhanced by the first-order gradient method and a new optimization algorithm is introduced as GPSG. In metaheuristic methods, some search directions are selected at random and the resulting points gradually progress toward the optimal. Since the gradient direction usually has the largest decrease in the desired function, it is added to the GSA and PSO process to allow for faster and more accurate convergence. By integrating the metaheuristic methods with the gradient directions, a powerful method for optimizing functions has been made possible. Numerous examples of unconstrained problems of mathematical functions of CEC2005 and constrained examples of stress and displacement structural design problems have been chosen to demonstrate the reliability and capability of the presented method.

Full Text

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Figures

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Convergence history for CEC2005 with $NP = 5$

Figure 2

Convergence history for F1 by algorithms with different number of particles

Figure 3

Convergence history for F10 by algorithms with different number of particles

Figure 4

Convergence history for F17 by algorithms with different number of particles

Figure 5

Convergence history for F20 by algorithms with different number of particles

Figure 6

Convergence history for F25 by GSA algorithm with different number of particles

Figure 7

10-bar plane truss

Figure 8

Convergence history for the 10-bar truss with different number of particles

Figure 9

72-bar truss

Figure 10

Convergence history for the 72-member truss with different number of particles

Figure 12

Convergence history for the 120-member truss with different number of particles