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PII: S2288-4300(16)30114-2
DOI: http://dx.doi.org/10.1016/j.jcde.2017.02.005
Reference: JCDE 86

To appear in: *Journal of Computational Design and Engineering*

Received Date: 1 October 2016
Revised Date: 17 November 2016
Accepted Date: 15 February 2017

Please cite this article as: M. Kohli, S. Arora, Chaotic grey wolf optimization algorithm for constrained optimization problems, *Journal of Computational Design and Engineering* (2017), doi: http://dx.doi.org/10.1016/j.jcde.2017.02.005

Chaotic grey wolf optimization algorithm for constrained optimization problems

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Abstract

The Grey Wolf Optimizer (GWO) algorithm is a novel meta-heuristic, inspired from the social hunting behavior of grey wolves. This paper introduces the chaos theory into the GWO algorithm with the aim of accelerating its global convergence speed. Firstly, detailed studies are carried out on thirteen standard constrained benchmark problems with ten different chaotic maps to find out the most efficient one. Then, the chaotic GWO is compared with the traditional GWO and some other popular meta-heuristics viz. Firefly Algorithm, Flower Pollination Algorithm and Particle Swarm Optimization algorithm. The performance of the CGWO algorithm is also validated using five constrained engineering design problems. The results showed that with an appropriate chaotic map, CGWO can clearly outperform standard GWO, with very good performance in comparison with other algorithms and in application to constrained optimization problems.

Keywords: Chaotic grey wolf optimization, Firefly algorithm, Flower pollination algorithm, Particle swarm optimization algorithm.

1. Introduction

Constraints represent a feasible region which is nonempty and is filled with some restrictions or constraints to be followed by the solutions to solve a specific optimization problem [1]. In general terms, constraints can be classified into equality constraints and inequality constraints which are represented in the form of mathematical equality and inequality equations respectively. Both types of constraints need to be satisfied by the problem's decision variables. Earlier, some deterministic methods like feasible direction approach and generalized gradient descent method were developed for solving constraint problems [2]. However, due to their limited applicability and complexity of constraints, these were not effective for real world applications like structural optimization problems, economical optimization, location problems and engineering design problems like spring design, welded beam design ,

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