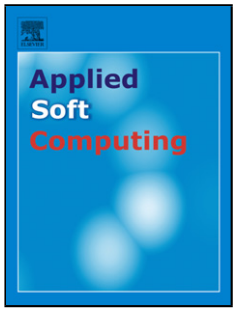

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An Interval Space Reducing Method for Constrained Problems with Particle Swarm Optimization

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Abstract

In this paper, we propose a method for solving constrained optimization problems using Interval Analysis combined with Particle Swarm Optimization. A Set Inverter Via Interval Analysis algorithm is used to handle constraints in order to reduce constrained optimization to quasi unconstrained one. The algorithm is useful in the detection of empty search spaces, preventing useless executions of the optimization process. To improve computational efficiency, a Space Cleaning algorithm is used to remove solutions that are certainly not optimal. As a result, the search space becomes smaller at each step of the optimization procedure. After completing pre-processing, a modified Particle Swarm Optimization algorithm is applied to the reduced search space to find the global optimum. The efficiency of the proposed approach is demonstrated through comprehensive experimentation involving 100,000 runs on a set of well-known benchmark constrained engineering design problems. The computational efficiency of the new method is quantified by comparing its results with other PSO variants found in the literature.

Keywords: Interval Analysis, Evolutionary computation, Particle Swarm Optimization, Constrained Optimization

1. Introduction

There are many optimization problems for which it is very hard to find the best possible solution within a reasonable amount of time. One way of solving these problems is to use evolutionary algorithms, which are a class of computational intelligence methods guided by the use of stochastic heuristics [4].

Particle Swarm Optimization (PSO) is an evolutionary algorithm inspired by the movement of particles on a n-dimensional space. It works by generating many different possible solutions, searching for the best one and moving the values of the others in a manner similar to the movement of a flock of birds. It can be used to solve unconstrained as well as constrained optimization problems. However, the use of PSO for solving constrained problems may generate many invalid candidate solutions, negatively affecting the efficiency of the method.