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Research Article

Improve Particle Swarm Optimization and Differential Evolution Algorithms Using Nash Bargaining Theory

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Abstract

This article proposes a new approach in solving optimization (issues) problems in which two known optimization algorithm of particle swarm algorithm (PSO) and differential evolution (DE) a cooperate. The proposed approach uses a coalition or cooperation model in the game theory to improve the DE and PSO algorithms. This is done in an attempt to keep a balance between the exploration and exploitation capabilities by preventing population stagnation and avoiding the local optimum. The DE and PSO algorithms are two players in the state space, which play cooperative games together using the Nash bargaining theory to find the best solution. To evaluate the performance of the proposed algorithm, 25 benchmark functions are used in terms of the CEC2005 structure. The proposed algorithm is then compared with the classical DE and PSO algorithms and the hybrid algorithms recently proposed. The results indicated that the proposed hybrid algorithm outperformed the classical algorithms and other hybrid models.

Keywords: Cooperative Game Theory, Nash Bargaining Theory, Differential Evolution, Particle Swarm Optimization.

Highlights

- The game environment creates a competitive environment between algorithms and greatly increases the searching ability of the algorithms.
- The profit earned from Nash bargaining is the best solution for both algorithms due to their Pareto optimality property.
- The exchange of profits earned from the game between the algorithms leads to exploring new areas in the search environment, increasing diversity, and avoiding the local optimum.
- The condition of the Nash bargaining theorem helps to maintain a balance between the exploration and exploitation capabilities in the proposed method.

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