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Dimensional decision covariance colony predation algorithm: global optimization and high−dimensional feature selection

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Abstract
The colony Predation Algorithm (CPA) has been proven to be one of the heuristic algorithms that can efficiently solve global optimization problems. Balancing the paradox between exploration and exploitation capabilities while mitigating premature convergence are two key subjects that need to be addressed in CPA research. To effectively alleviate these problems, this study proposes a CPA variant named Covariance Gaussian cuckoo Colony Predation Algorithm (CGCPA). Specifically, the designed gaussian cuckoo variable dimensional strategy is used to decentralize the agent population in CPA to enhance the search agents' population diversity and global search ability. The covariance matrix adaptation evolution strategy is used to enhance the convergence speed of the evolutionary agents and the ability to capture the global optimal solution at a later stage. This study subjects CGCPA to competitive experiments with ten basic metaheuristics and ten state−of−the−art algorithms on the IEEE CEC 2017 function test suite. Experimental results confirm that CGCPA outperforms several state−of−the−art DE variants and the latest proposed algorithms in terms of convergence speed and accuracy. In addition, this study proposes a discrete binary feature selection method to better select features in medical data classification named BCGCPA. Its feature selection capability is evaluated in detail on 12 high−dimensional biomedical datasets in the UCI machine learning repository. BCGCPA achieves the lowest classification error rate on all 12 high−dimensional datasets, realizing the best feature selection classification accuracy. BCGCPA can be an efficient pre−processing tool for the dimensionality reduction of high−dimensional biomedical data. It has crucial applications in search space optimization and feature selection of medical datasets.

Keywords Colony predation algorithm · Swarm intelligence · Global optimization · Feature selection

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