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Insights into the effects of control parameters and mutation strategy on self-adaptive ensemble-based differential evolution

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ABSTRACT

This work explores the challenges in identifying appropriate and significant parameter configurations in differential evolution (DE) under the influence of population diversity and dimension size. For most DE algorithms, the configuration of control parameters is a vital prerequisite for balancing exploration and exploitation within the confinement of a search space. This study investigates the implementation of various adaptive parameter setting configurations on benchmark functions via the proposal of an algorithmic scheme called self-adaptive ensemble-based DE (SAEDE). This algorithm uses self-adaptive and ensemble mechanisms to set the relevant parameters for each generation. SAEDE is compared with two other ensemble-based DEs, and their performance is evaluated using 34 benchmark functions consisting of 20 low dimensions and 14 high dimensions. Furthermore, the convergence of these DEs is tested by using *Q*-measure. Experimental results indicate that SAEDE achieves the highest frequency of maximum success rate in 28 out of the 34 benchmark functions. SAEDE also achieves the lowest *Q*-measure of 4237318. These findings show the competitiveness and efficiency of SAEDE in locating optimal solutions while avoiding exhaustive searches of suitable parameters by users in terms of achieving optimization while minimizing the dependency on user setting.

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1. Introduction

Artificial intelligence (AI) has been widely applied in various domains owing to its capability to solve uncertain and complex problems. Previously, AI was used to obtain solutions for stationary optimization and static environments, but this purpose has changed. The computational paradigm in AIs capability has shifted. Instead of solving static problems, AI solves dynamic and complex problems, such as complexity science. In-depth understanding on complexity science, especially problems related to dynamic human populations, is beneficial for risk mitigation in various scenarios, such as crowd disasters,

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