Mitran Madalina-Andreea,
madalina.mitran96@e-uvt.ro,
orcid: 0000-0002-7946-7054,
West University of Timisoara, Romania

Towards Autonomous Bound Constraint Handling Operator in Differential Evolution

In the context of bound-constrained optimization problems, Differential Evolution (DE) algorithms often generate candidate solutions that violate their feasible bounds due to the mutation operator. To overcome the limitation of relying on a single Bound Constraint Handling Method (BCHM), an enhancement to DE is proposed by integrating an adaptive correction operator that selectively applies suitable correction methods, ensuring solutions remain within feasible bounds.

To effectively implement an adaptive BCHM, two key components are required: (i) a sufficiently varied pool of BCHM and (ii) a strategy for adaptive selection. The adaptive selection strategy for this operator leverages Estimation of Distribution Algorithms (EDAs). In this approach, a Bayesian network is constructed to model the probabilistic relationships between BCHMs and various measures, such as the error relative to the known global optimum, the number of successful trial vectors in each generation, along with statistical characteristics of the population such as variance, Kullback-Leibler divergence from a uniform distribution, and probability of generating infeasible solutions, are incorporated into the Bayesian network.

The Bayesian network is trained using data collected from the performance of various correction methods applied to infeasible solutions across multiple generations. This data includes the effectiveness of each method in maintaining feasibility and improving fitness. During each generation, the Bayesian network performs probabilistic inference to select the most effective correction method for each infeasible trial vector. By leveraging the conditional probabilities derived from historical and current performance measures, the network intelligently adapts to the evolving optimization landscape, improving the DE algorithm's ability to handle boundary constraints.

This integration enhances the overall performance of DE by providing a more autonomous and intelligent mechanism for constraint handling. This proposal aligns with the purpose of the workshop by introducing a novel probabilistic model for EDAs, specifically tailored to enhance DE algorithms applied in the context of bound constrained optimization problems.

Internal