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Simultaneous Multi-Metaheuristic Coordination for Combinatorial Optimization

Communication Info

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Abstract

Efficient cooperation among heterogeneous metaheuristic agents is crucial for solving complex combinatorial optimization problems, particularly when problem sizes and structural complexity exceed the capabilities of single algorithms. This study investigates the design and evaluation of a parallel communication mechanism within a multi-metaheuristic system, where multiple diverse metaheuristic agents operate simultaneously and exchange solution information in real time. Unlike traditional isolated or sequential communication schemes, parallel communication enables concurrent information sharing, allowing agents to influence each other's search trajectories and dynamically balance exploration and exploitation.

The proposed framework builds upon multi-agent metaheuristic optimization concepts, where cooperative information sharing enhances search efficiency and solution quality. Inspired by the work of Silva et al. [1], agents share best solutions and adaptive feedback, fostering cross-algorithm learning and mitigating premature convergence. Computational experiments on benchmark Capacitated Vehicle Routing Problem (CVRP) instances demonstrate that parallel communication accelerates convergence, improves solution quality, and enhances robustness compared to isolated or sequentially communicating metaheuristics. These results highlight the potential of parallel communication as an effective strategy for collaborative metaheuristic optimization in complex combinatorial domains.

References

[1] Lopes, Maria & Souza, Sérgio & Souza, Marcone & Oliveira, Sabrina. (2015). A Multi-agent Metaheuristic Optimization Framework with Cooperation. 104-109. 10.1109/BRACIS.20s15.64.