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Peer Review

Review of: "PSO and the Traveling Salesman Problem: An Intelligent Optimization Approach"

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The paper explores the application of Particle Swarm Optimization (PSO) to the Traveling Salesman Problem (TSP), a well-established NP-hard combinatorial optimization challenge. The authors adapt PSO, originally developed for continuous optimization, to the discrete domain of TSP and incorporate 2-opt and 3-opt local search techniques. The study evaluates PSO's performance on a small-scale instance with five cities and compares it to Genetic Algorithms (GA) and Simulated Annealing (SA). While the topic is relevant and the PSO adaptation is interesting, the paper lacks depth in several areas, limiting the strength of its conclusions.

Strengths of the paper

1. The introduction effectively highlights the importance of TSP and its applications in logistics, route planning, and bioinformatics, providing a solid foundation for the study.
2. The approach of treating city orders as permutations and enhancing PSO with local search demonstrates an awareness of the challenges in applying PSO to discrete problems.
3. The paper is organized in a coherent manner, progressing from an introduction to PSO and TSP, methodology, results, and conclusions, which aids readability.
4. The experiment with five cities offers a preliminary demonstration of PSO's capability to find competitive solutions for small TSP instances.

Weaknesses

1. The evaluation is confined to a single TSP instance with five cities, which is insufficient to support broader claims about PSO's performance, especially given the stated use of benchmark

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instances (Limited Experimental Scope).

2. The pseudocode in Section 4 is truncated and lacks critical details, such as the full loop structure, velocity updates, and integration of local search, hindering reproducibility.
3. While the paper mentions comparisons with GA and SA, no specific results, metrics, or data are provided to substantiate these claims, weakening the performance evaluation.
4. The acknowledgment that PSO struggles with larger instances due to local optima is brief and lacks analysis of why this occurs or how it compares to other methods.
5. Small-Scale Experiment: The experiment's configuration (e.g., 30 particles, ω=0.8\omega = 0.8ω=0.8, c1=c2=2c_1 = c_2 = 2c1=c2=2) is presented without justification, and the five-city instance limits insights into scalability.
6. Figure 1, described as a graph of the five-city TSP solution, is not included in the document, leaving readers unable to assess its contribution.
7. Limited Mathematical Clarity: The transition from continuous PSO equations to a discrete TSP adaptation is not fully explained, leaving gaps in how velocity and position updates produce valid permutations.
8. Unclear Novelty: The paper cites prior work on PSO for TSP (e.g., Ghosh and Dehuri, 2011) but does not clearly articulate what distinguishes this study from existing research.

After careful review of the manuscript, I recommend rejection in its current form. While the paper tackles an interesting and relevant problem—applying Particle Swarm Optimization (PSO) to the Traveling Salesman Problem (TSP)—and demonstrates some understanding of the domain, it falls short of the standards required for a meaningful contribution to the field. The experimental scope is severely limited to a single, small instance of five cities, which does not adequately test the algorithm's capabilities or support the claims of competitiveness with established methods like Genetic Algorithms (GA) and Simulated Annealing (SA). Furthermore, the pseudocode is incomplete, lacking critical details necessary for replication, and the comparison with other algorithms is superficial, with no concrete data provided. The discussion of results and limitations is brief and lacks depth, particularly regarding PSO's challenges with larger instances.

Additionally, the absence of key figures (e.g., Figure 1) and the unclear distinction of this work's novelty relative to prior studies further weaken its impact. In its present state, the paper does not offer sufficient rigor, evidence, or originality to justify publication. A substantial overhaul addressing these issues would be required for reconsideration, but as it stands, it does not meet the threshold for acceptance.

Declarations

Potential competing interests: No potential competing interests to declare.