

Peer Review

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

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This paper investigates the use of Particle Swarm Optimization (PSO), adapted for the discrete nature of the Traveling Salesman Problem (TSP), and enhanced with local search techniques. While the topic is relevant, the manuscript currently presents several issues that need to be addressed to improve the **clarity, scientific rigor, and contribution** of the work.

1. Introduction – Contextualization and Motivation

The introduction is too brief and lacks sufficient depth. It should provide a more comprehensive contextualization of the TSP, emphasizing its practical importance and the challenges involved in solving it efficiently. A more detailed explanation of PSO and its adaptation to discrete optimization problems, such as the TSP, is also needed. Furthermore, the introduction must establish the **state of the art**, including **recent surveys and review papers** that highlight current interest in this area. A quick search (e.g., through Google Scholar) reveals at least 17 review papers on the TSP published since 2020. These should be cited to emphasize that, despite being a classical problem, the TSP remains a **relevant and active research topic**.

Search string for Google Scholar:

allintitle: review OR survey "Traveling Salesman Problem"

Results:

[https://scholar.google.com.br/scholar?](https://scholar.google.com.br/scholar?as_q=&as_epq=Traveling+Salesman+Problem&as_oq=review+survey&as_eq=&as_occt=title&as_sauthors=&as_publication=&as_ylo=2020&as_yhi=&hl=pt-BR&as_sdt=0%2C5)

[as_q=&as_epq=Traveling+Salesman+Problem&as_oq=review+survey&as_eq=&as_occt=title&as_sauthors=&as_publication=&as_ylo=2020&as_yhi=&hl=pt-BR&as_sdt=0%2C5](https://scholar.google.com.br/scholar?as_q=&as_epq=Traveling+Salesman+Problem&as_oq=review+survey&as_eq=&as_occt=title&as_sauthors=&as_publication=&as_ylo=2020&as_yhi=&hl=pt-BR&as_sdt=0%2C5)

2. References – Update and Relevance

- The reference supporting the statement "Recently, several adaptations have been proposed to extend its application to discrete problems, such as the TSP [6]" is outdated (from 2011).
- Similarly, the reference used to support "TSP continues to be widely studied..." [9] is also not recent (from 2006).

Please revise and update the references using **more current and relevant citations**, ideally from the last five years.

Some important references:

- Wang, K. P., Huang, L., Zhou, C. G., & Pang, W. (2003, November). Particle swarm optimization for traveling salesman problem. In *Proceedings of the 2003 international conference on machine learning and cybernetics (IEEE cat. no. 03ex693)*(Vol. 3, pp. 1583-1585). IEEE.
- Pop, P. C., Cosma, O., Sabo, C., & Sitar, C. P. (2024). A comprehensive survey on the generalized traveling salesman problem. *European Journal of Operational Research*, 314(3), 819-835.

3. Section 3.2 – PSO Adaptation for TSP

This section is too brief and abstract. It would benefit greatly from the inclusion of a **concrete example** that shows how a particle's position (a permutation of cities) is updated during the optimization process. This would significantly improve the reader's understanding of how PSO is adapted to the discrete nature of the TSP.

4. Section 3.3 – Local Search Techniques

The statement “Some techniques that can be used for local search include 2-opt and 3-opt...” should be supported by at least **one solid reference**. Furthermore, these techniques should be **explained in the manuscript**, either with diagrams, pseudocode, or illustrative examples, to improve clarity and completeness.

5. Algorithm 1 – Objective Function

The “objective function” mentioned in line 2 of Algorithm 1 is not explicitly defined anywhere in the paper. It should be clearly stated—presumably, this refers to the **total tour length** in the TSP.

6. Section 5 – Results and Discussion

The **comparative analysis** promised in both the abstract and Section 3.4 (with Genetic Algorithm and Simulated Annealing) is missing. This is a serious omission and weakens the validity of the claimed results. At a minimum, the authors should present **performance metrics** (such as best tour length, convergence behavior, and execution time) across PSO, GA, and SA, using **standard benchmark datasets** (for example: TSPLIB, a library of sample instances maintained by Reinelt (1991) - <http://comopt.ifl.uni-heidelberg.de/software/TSPLIB95/>).

7. Experiment Design – Scope and Relevance

The only experiment presented is **too simple**, involving a very small number of cities. This is insufficient to evaluate the **scalability** and **robustness** of the proposed approach. The authors state that PSO works well for small and medium-sized problems and suffers with larger instances due to local minima—but **no experimental evidence or literature references** are provided to support this claim. To substantiate such statements, additional experiments should be conducted using **larger TSP instances** (e.g., with 50, 100, or 200 cities), and the results should be compared with those of GA and SA.

8. Parameter Justification – Section 5.1

The parameter values listed (inertia factor, learning factors, number of particles, and max number of interactions) are unjustified. The authors should clarify whether these values were chosen based on **previous literature, empirical tuning, trial-and-error**, and whether any **sensitivity analysis** was conducted.

With the above improvements, the paper could make a more meaningful contribution to the field.

Declarations

Potential competing interests: No potential competing interests to declare.