

Reviewer Report

Manuscript: Bio-inspired and Evolutionary Computing: Aspects of Project and Theory

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Reviewer Model: Gemini

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1. Executive Summary

The manuscript provides a detailed examination of nature-inspired computational methodologies, specifically focusing on **Evolutionary Computation (EC)**, **Swarm Intelligence (SI)**, and **Neuro-evolution**. The work effectively balances theoretical mathematical formalisms with practical implementation guides and computational results. The manuscript is well-suited for a periodical focused on computational intelligence, though some areas regarding comparative analysis and cutting-edge trends could be strengthened. [👍+1](#)

2. Key Strengths

- **Comprehensive Theoretical Foundation:** The author provides a robust mathematical framework for core algorithms, including the velocity update equations for **Particle Swarm Optimisation (PSO)** and the state transition/pheromone update rules for **Ant Colony Optimisation (ACO)**. [👍+2](#)
- **Clarity of Methodology:** The decomposition of **Genetic Algorithms (GAs)** into initialisation, fitness evaluation, selection (e.g., roulette wheel), crossover, and mutation is logically presented and standardly rigorous. [👍+4](#)
- **High-Quality Visualisations:** The inclusion of 3D fitness landscape visualisations for benchmark functions (Sphere, Rastrigin, Rosenbrock, and Ackley) provides essential context for understanding why specific algorithms excel or struggle with certain topologies (e.g., the "valley" structure of the Rosenbrock function). [👍](#)
- **Empirical Validation:** The author provides quantitative proof of efficacy, demonstrating that PSO outperformed random search by several orders of magnitude across all tested benchmarks. [👍](#)

3. Mathematical & Algorithmic Assessment

- **Stochastic Modeling:** The paper correctly identifies these as population-based, stochastic heuristics that do not rely on gradient information, making them ideal for "black-box" optimisation. [👍+1](#)
- **Parameter Dynamics:** The discussion on the **inertia weight (w)** in PSO is particularly strong, correctly identifying how linearly decreasing w balances global exploration with local exploitation. [👍](#)
- **Multi-objective Focus:** The brief coverage of **NSGA-II** and Pareto-optimality adds necessary depth for real-world engineering applications where objectives are often conflicting. [👍](#)

4. Points for Improvement

- **Comparative Depth in Table 1:** While Table 1 compares PSO and Random Search, it lists "N/A" for the Genetic Algorithm across most benchmarks. To be a truly comprehensive computational study, the GA should be benchmarked against the same functions (Sphere, Rastrigin, etc.) as the PSO to provide a direct head-to-head comparison of different bio-inspired strategies. [👍](#)
- **Neuro-evolution Detail:** While Section 1 mentions neuro-evolution as a "fascinating convergence," the methodology section (Section 2) lacks the formal mathematical description for it that is provided for GAs, PSO, and ACO. Adding a section on topology evolution (e.g., NEAT) would balance the manuscript. [👍+1](#)
- **Computational Complexity:** A brief discussion on the time complexity per iteration for each algorithm relative to population size (N) would benefit practitioners looking to implement these in high-dimensional real-time systems.

5. Final Recommendation

Accept with Minor Revisions.

The manuscript is a high-quality synthesis of bio-inspired computing. Addressing the gaps in the comparative data (completing the GA benchmarks) and providing more formal detail on the neuro-evolution methodology would elevate the paper from a very good review to a top-tier research contribution.