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Energy-Efficient and Coverage-Optimized Wireless Sensor Networks using Multi-Objective Jellyfish Search Algorithm

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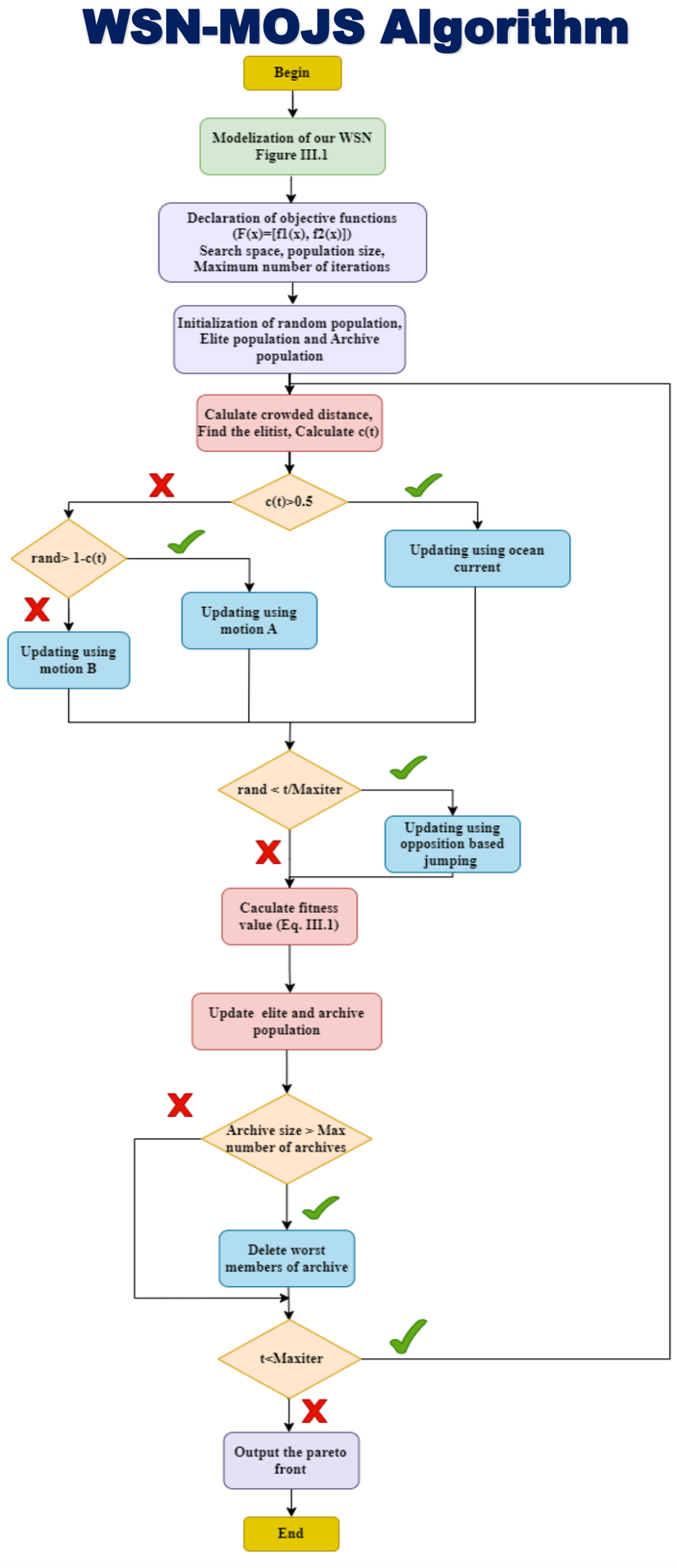
Abstract

This work presents the Multi-Objectives Jellyfish Search (MOJS) algorithm for optimizing Wireless Sensor Networks (WSNs), addressing challenges such as limited energy resources. WSNs use miniature, battery-powered sensors to monitor diverse environments, requiring efficient deployment strategies. Our proposed WSN-MOJS approach maximizes coverage while minimizing energy consumption. Simulations in MATLAB modeled sensor node placements within a designated zone, evaluated by coverage and energy objective functions. Iterative MOJS processes refined node placements over multiple runs. Results show WSN-MOJS achieves high coverage with minimal energy use and computational complexity. Increasing candidate solutions and iterations improves solution distribution and fitness values, highlighting its potential for efficient WSN deployment.

WSN-MOJS Algorithm



Objective Functions

F1: Maximization of the covered area of the zone

F2: Minimization of the energy expended by the sensor node

Simulation results

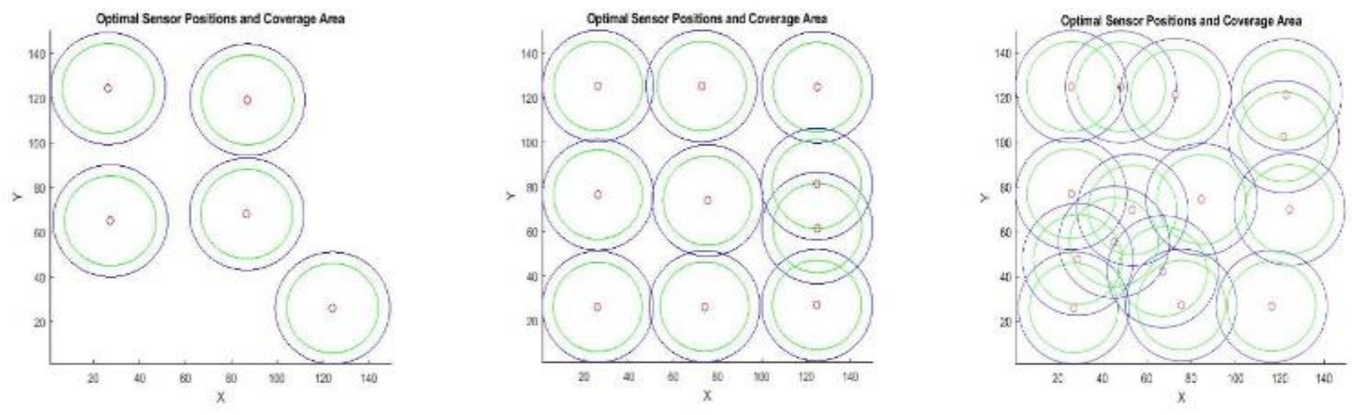


Figure 1: Network with different number of nodes (5, 10 and 15)

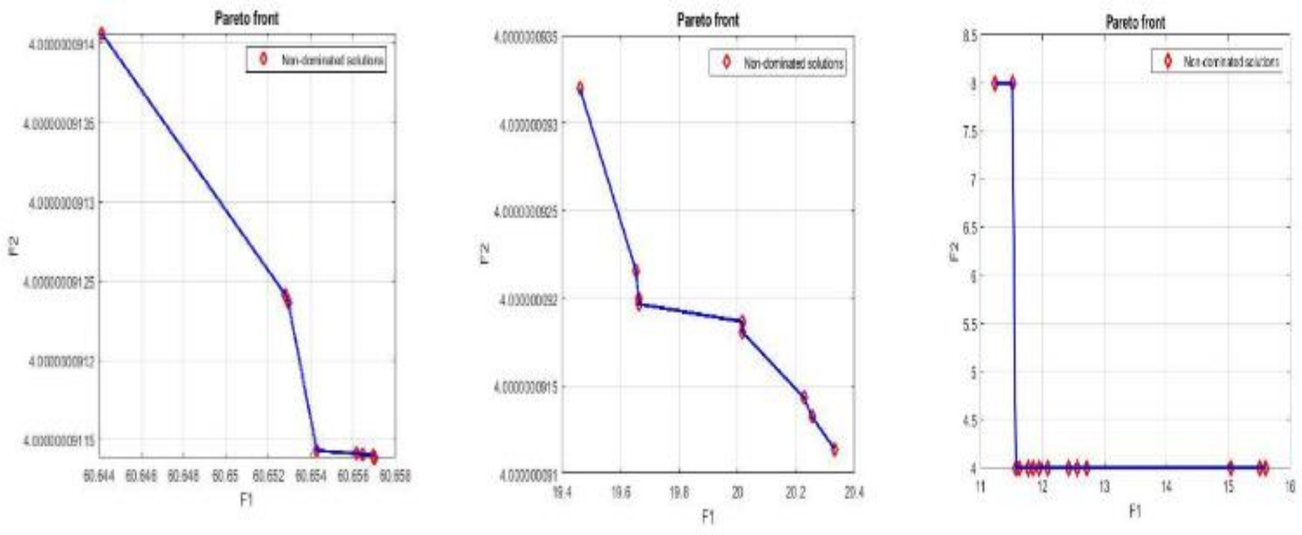


Figure 2: Pareto front with different number of nodes (5, 10 and 15)

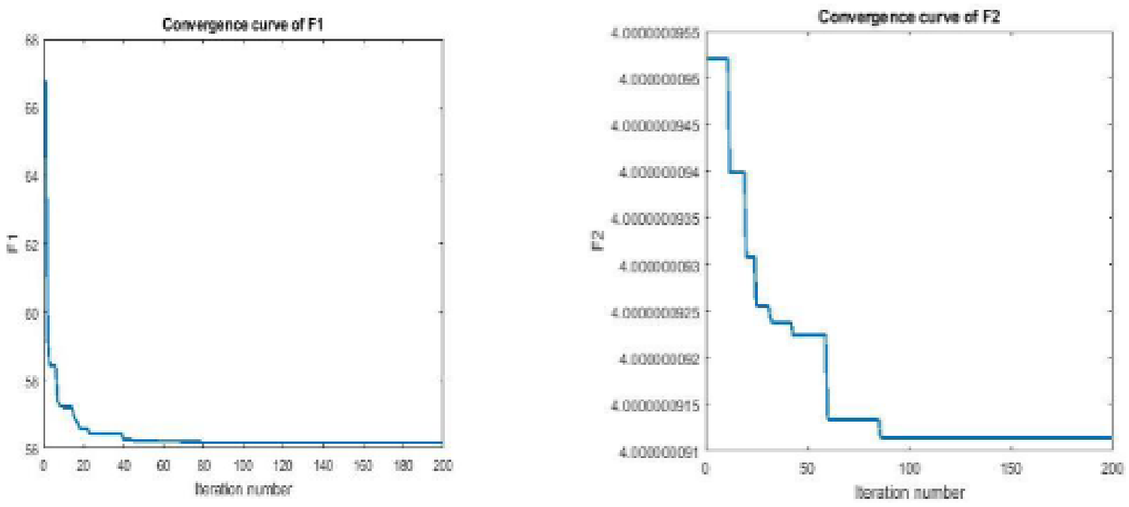


Figure 3: Convergence curves (Objective functions F1 and F2)

Conclusion

The WSN-MOJS algorithm effectively optimizes Wireless Sensor Networks by maximizing coverage and minimizing energy consumption. Its robust performance, even with limited computational resources, highlights its suitability for efficient sensor deployment in diverse environments. Enhanced solution distribution and fitness values demonstrate its potential for reliable and sustainable WSN implementations.

References

[1] Gao, X., & Zhao, X. (2020). Jellyfish Search Optimizer: A Novel Bio-Inspired Metaheuristic Algorithm for Global Optimization. Applied Mathematics and Computation, 388, 125535.