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A hybrid Meta-heuristic solution for Energy-Efficient routing in Software-Defined Wireless Sensor Network

POOJA MISHRA (mishrapooja427@gmail.com)

ABV Indian Institute of Information Technology and Management: Atal Bihari Vajpayee Indian Institute of Information Technology and Management https://orcid.org/0000-0001-5042-9671

NEETESH KUMAR

IIT Roorkee: Indian Institute of Technology Roorkee

W WILFRED GODFREY

ABV Indian Institute of Information Technology and Management: Atal Bihari Vajpayee Indian Institute of Information Technology and Management

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Abstract

Software-Defined Networking (SDN) has been adopted as an emerging networking paradigm within Wireless Sensor Networks (WSNs). SDN enables WSNs with self-configuration and programmable control to dynamically and efficiently manage the network functionalities. Generally, in WSN, smart sensing devices suffer from the low battery issue and they may be deployed in such environments where frequent recharge is not possible after the deployment. Therefore, this work focuses on energy-efficient routing problem considering Software-Defined Wireless Sensor Networks (SD-WSN) architecture. In SD-WSN, Control Server (CS) assigns the tasks to selected Control Nodes (CNs) dynamically. Thus, the CNs' selection process is developed as one optimization (NP-Hard) problem to make the network functional. To solve this problem effectively, a nature-inspired algorithm i.e., Grey Wolf Optimization (GWO) is hybridized with Particle Swarm Optimization (PSO) in order to improve its convergence and overall performance. This hybrid variant of GWO is dedicated to offering a Balanced clustering (BC) based routing protocol, this variant is referred to as HGWO-BC. Further, to solve the problem effectively, a fitness function is designed that considers several parameters e.g., intracluster distance, CS to CNs distance, nodes' residual energy, and cluster size. Thus, the proposed approach performs balanced, energy-efficient, and scalable clustering and prolongs the network life-time. To verify its effectiveness, an exhaustive simulation study is done. Comparative results show that the HGWO-BC approach outperforms other state-of-the-art approaches concerning network life-time, residual energy, network throughput, and convergence rate.

Full Text

Due to technical limitations, full-text HTML conversion of this manuscript could not be completed. However, the manuscript can be downloaded and accessed as a PDF.

Figures

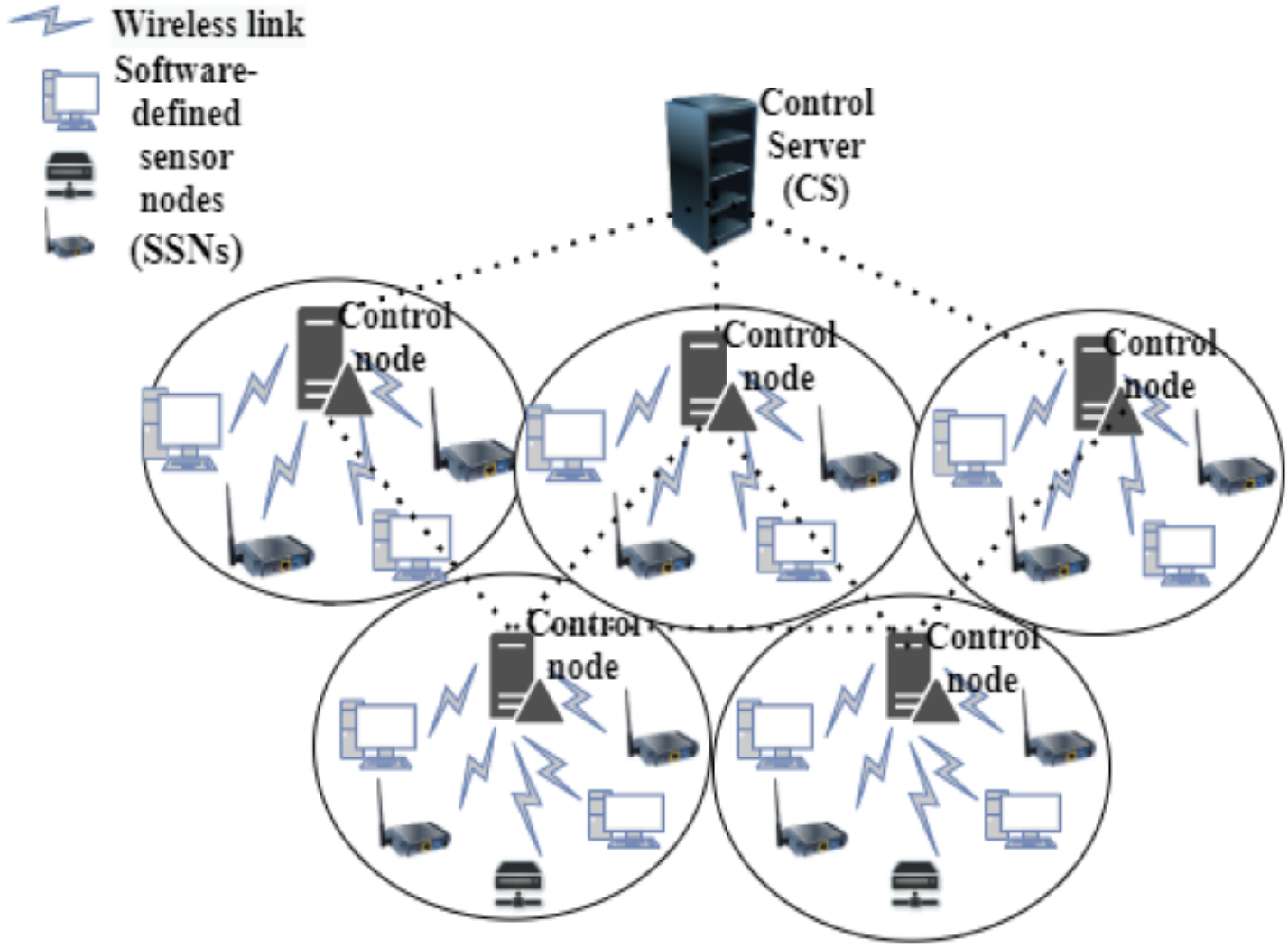

Figure 1

An example of multi-tasking SD-WSN.

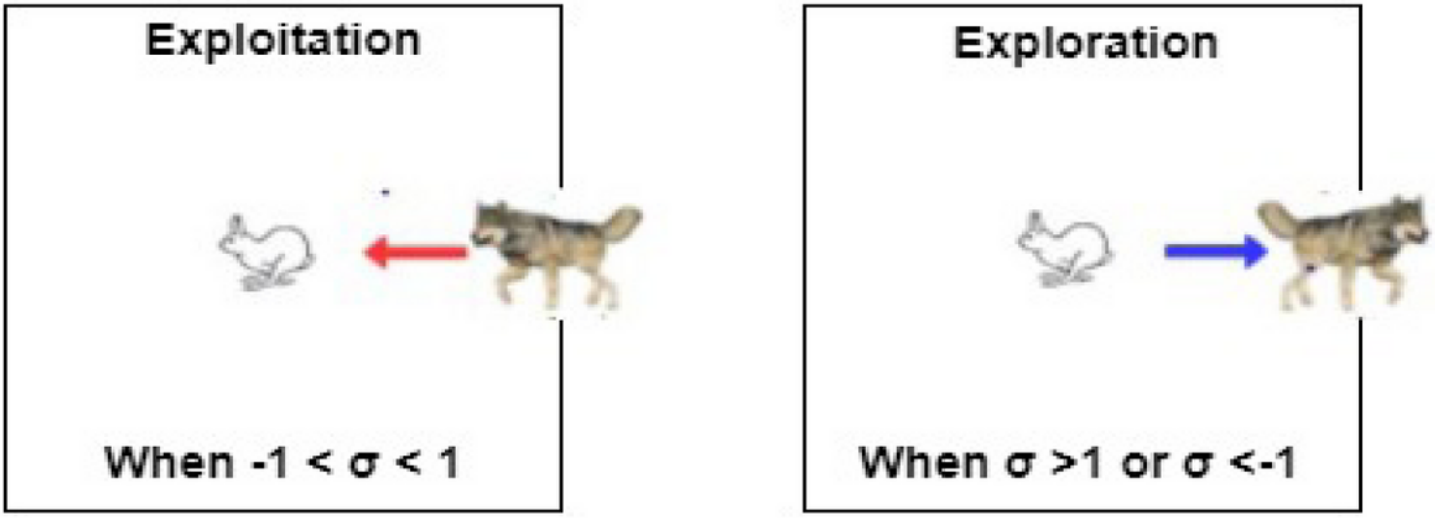

Figure 2

Exploitation vs. Exploration of GWO algorithm.

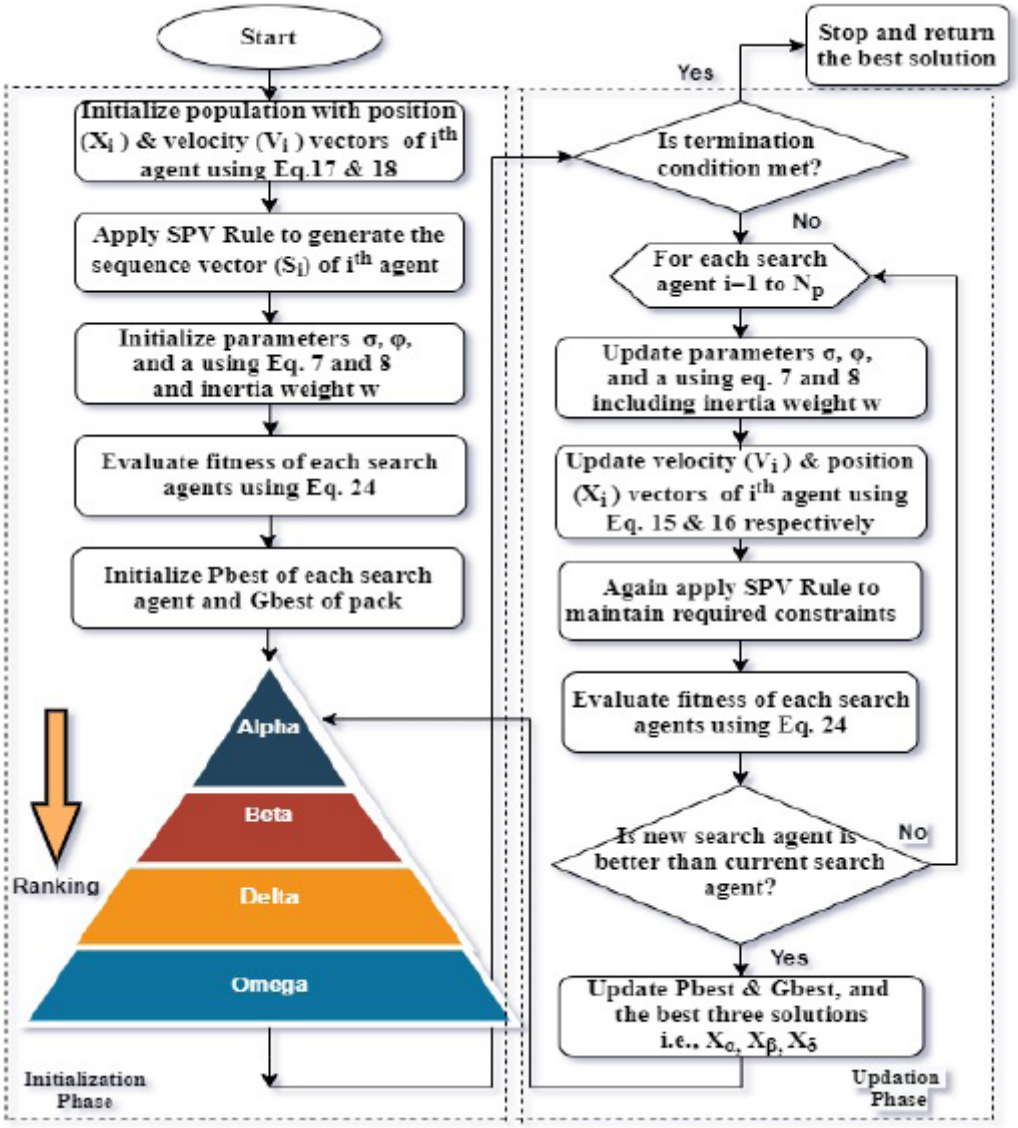

Figure 3

Flow of proposed HGWO-BC algorithm with social hierarchy.

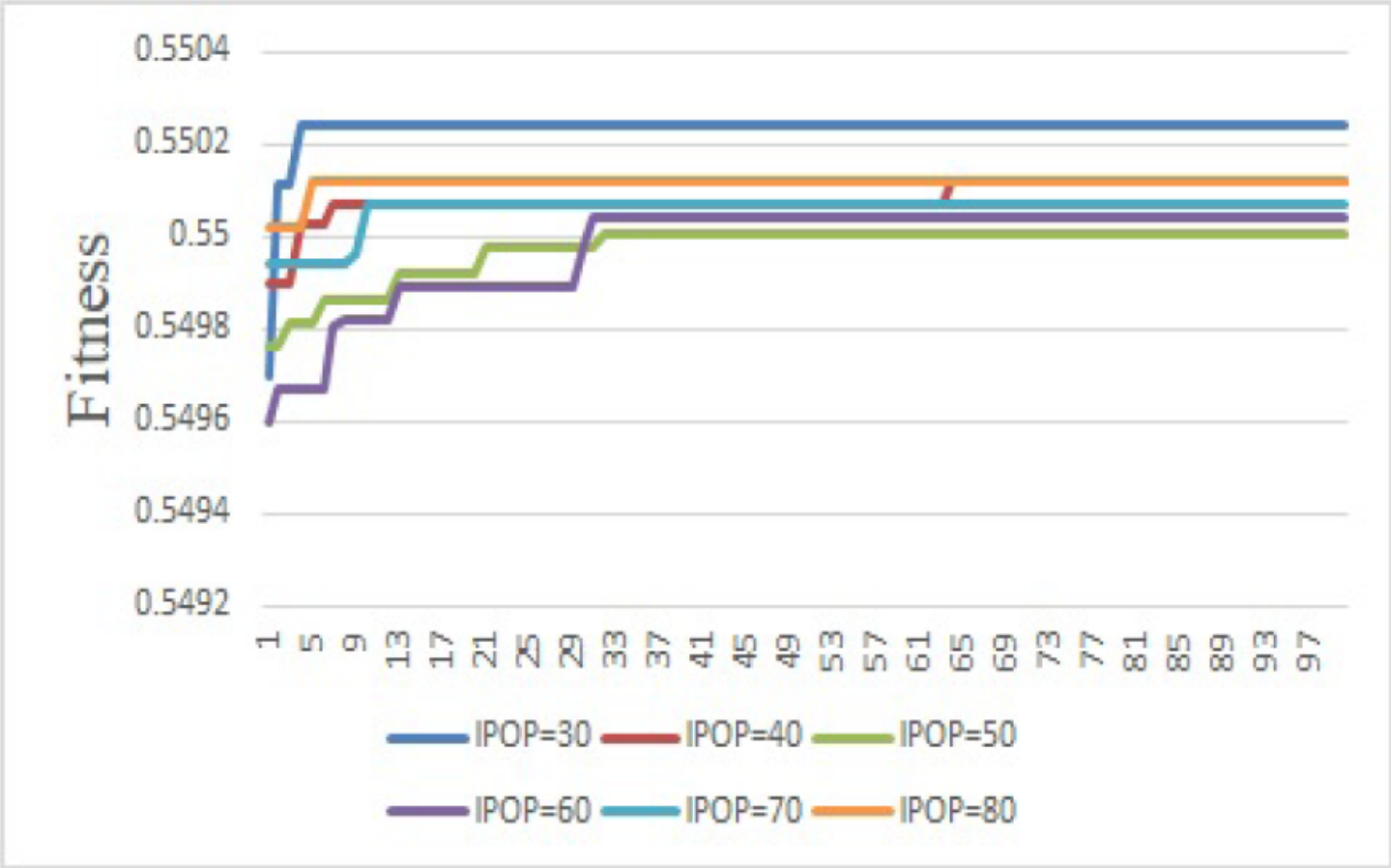

Figure 4

HGWO-BC's response to IPOP, tness value and iterations.

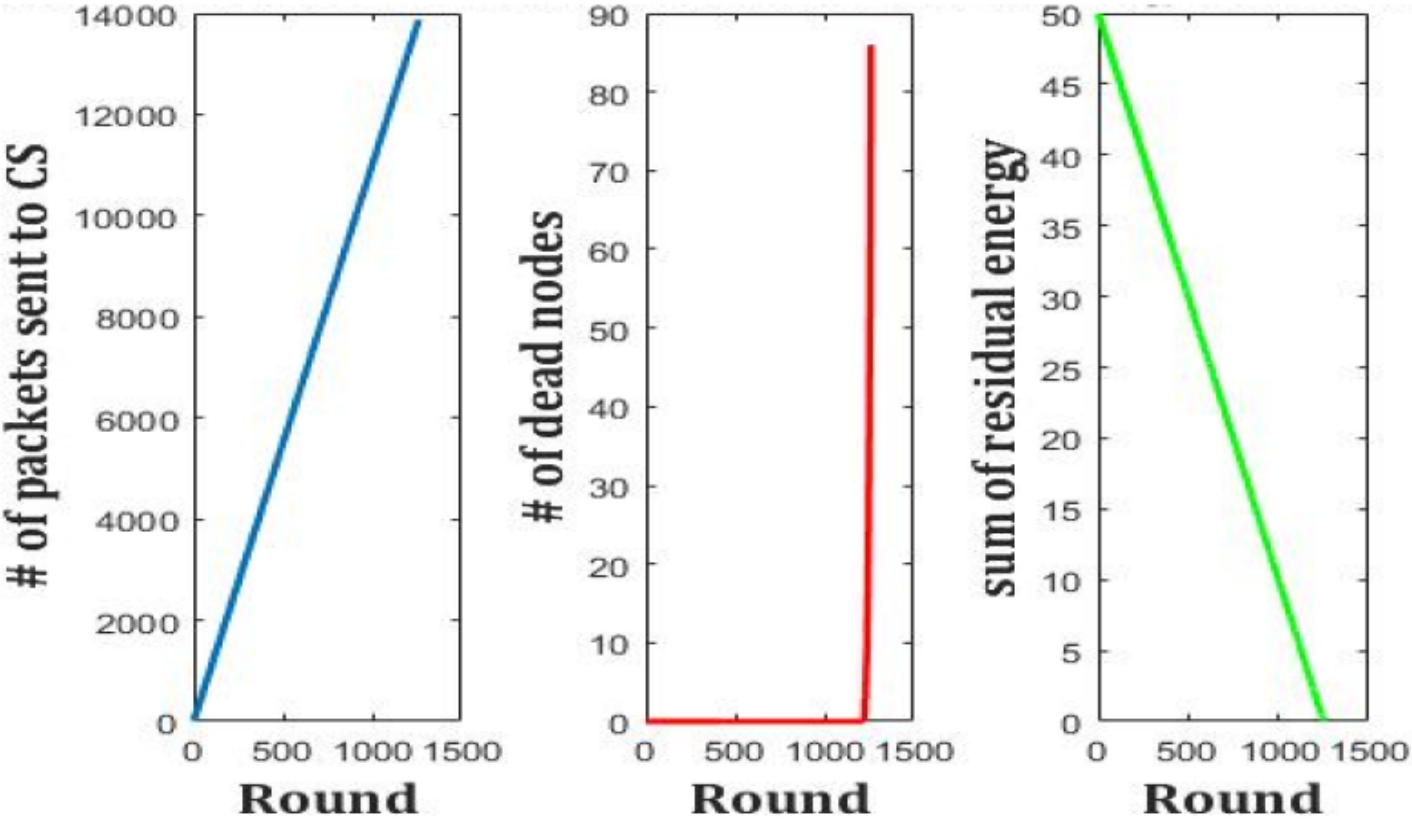

Figure 5

HGWO-BC's operation on transferred packets, dead nodes and energy.

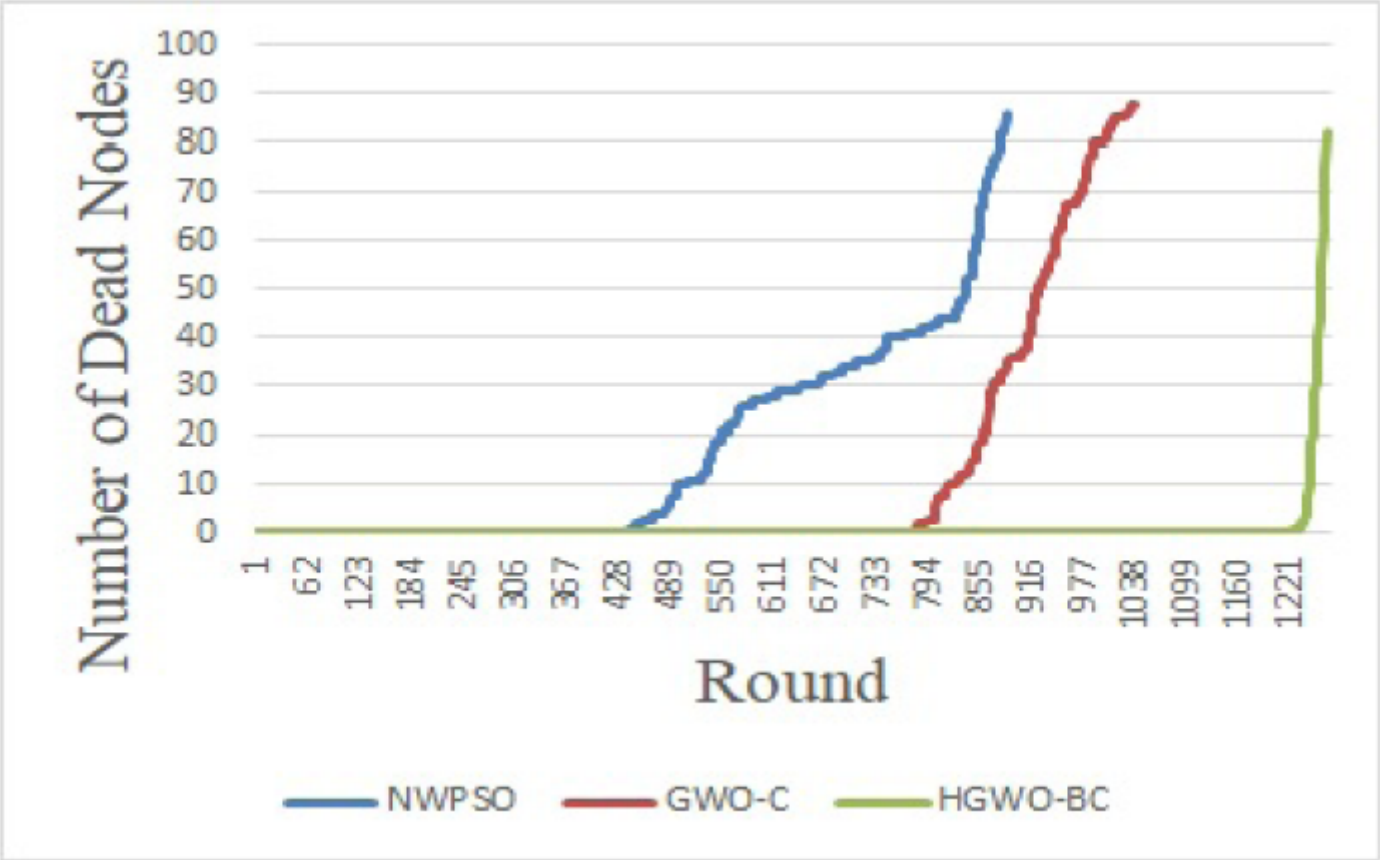

Figure 6

Comparison of HGWO-BC's dead nodes when CS is at the centre.

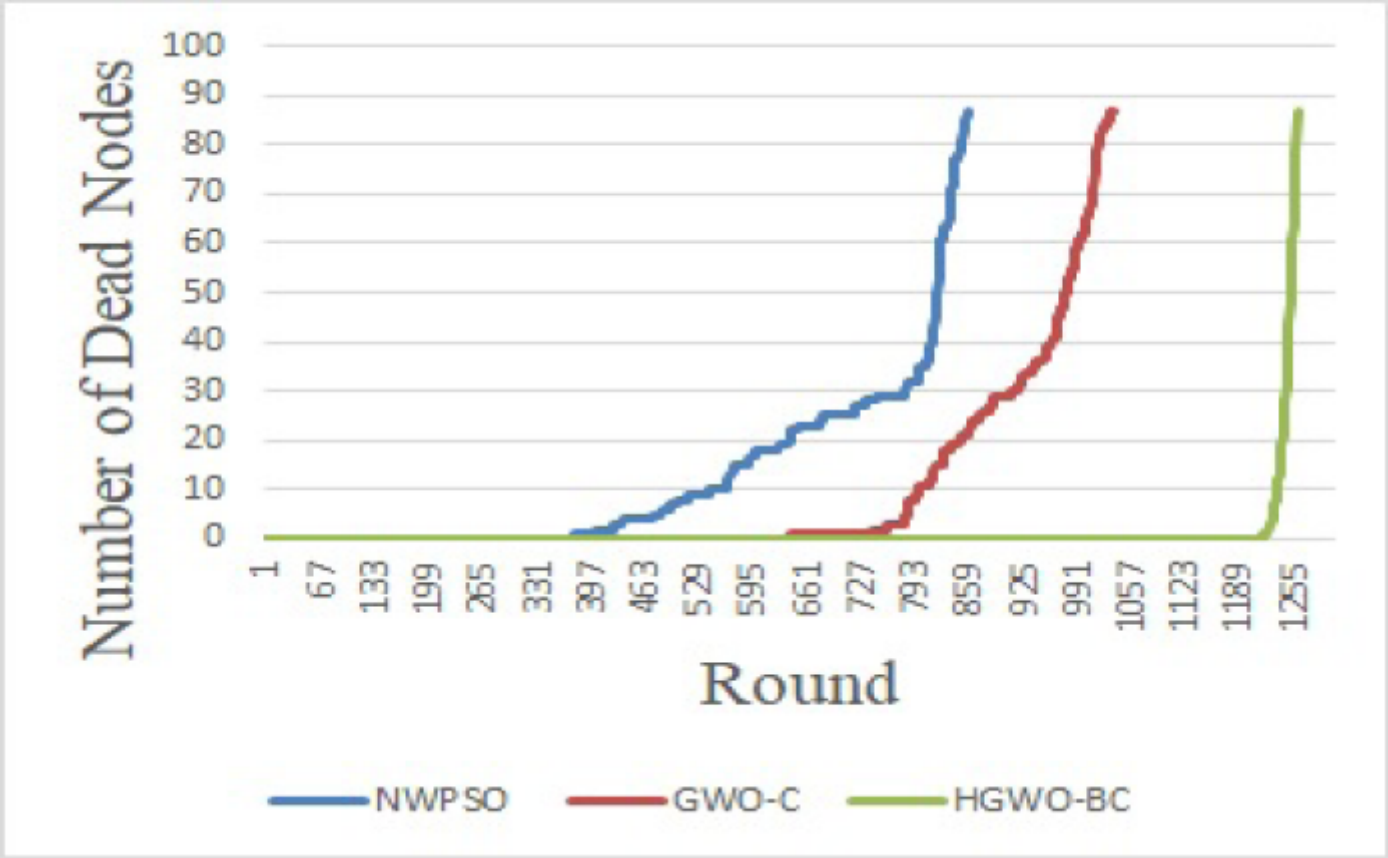

Figure 7

Comparison of HGWO-BC's dead nodes when CS is at the corner.

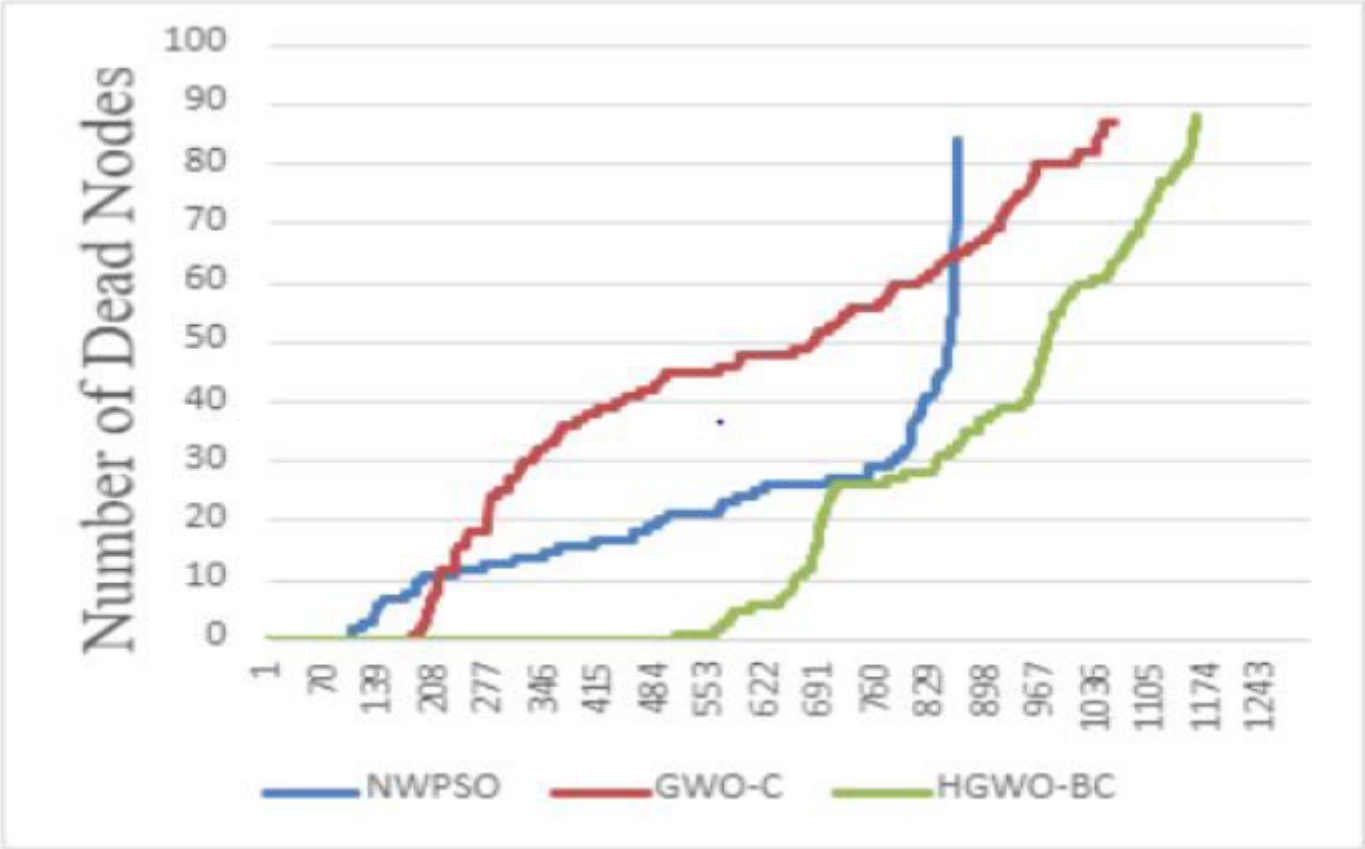

Figure 8

Comparison of HGWO-BC's dead nodes when CS is at the outside.

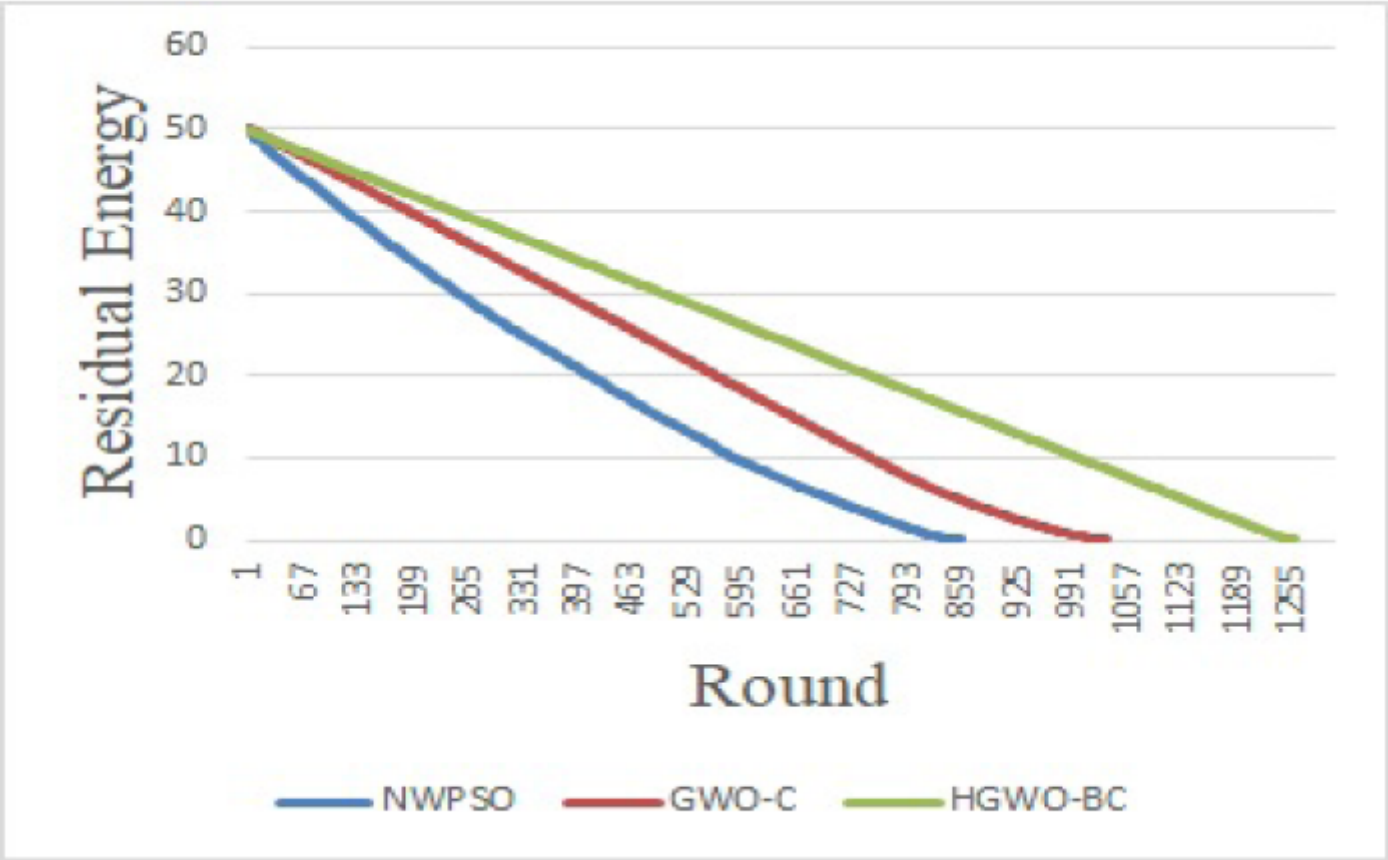

Figure 10

Comparison of HGWO-BC's residual energy when CS is at the corner.

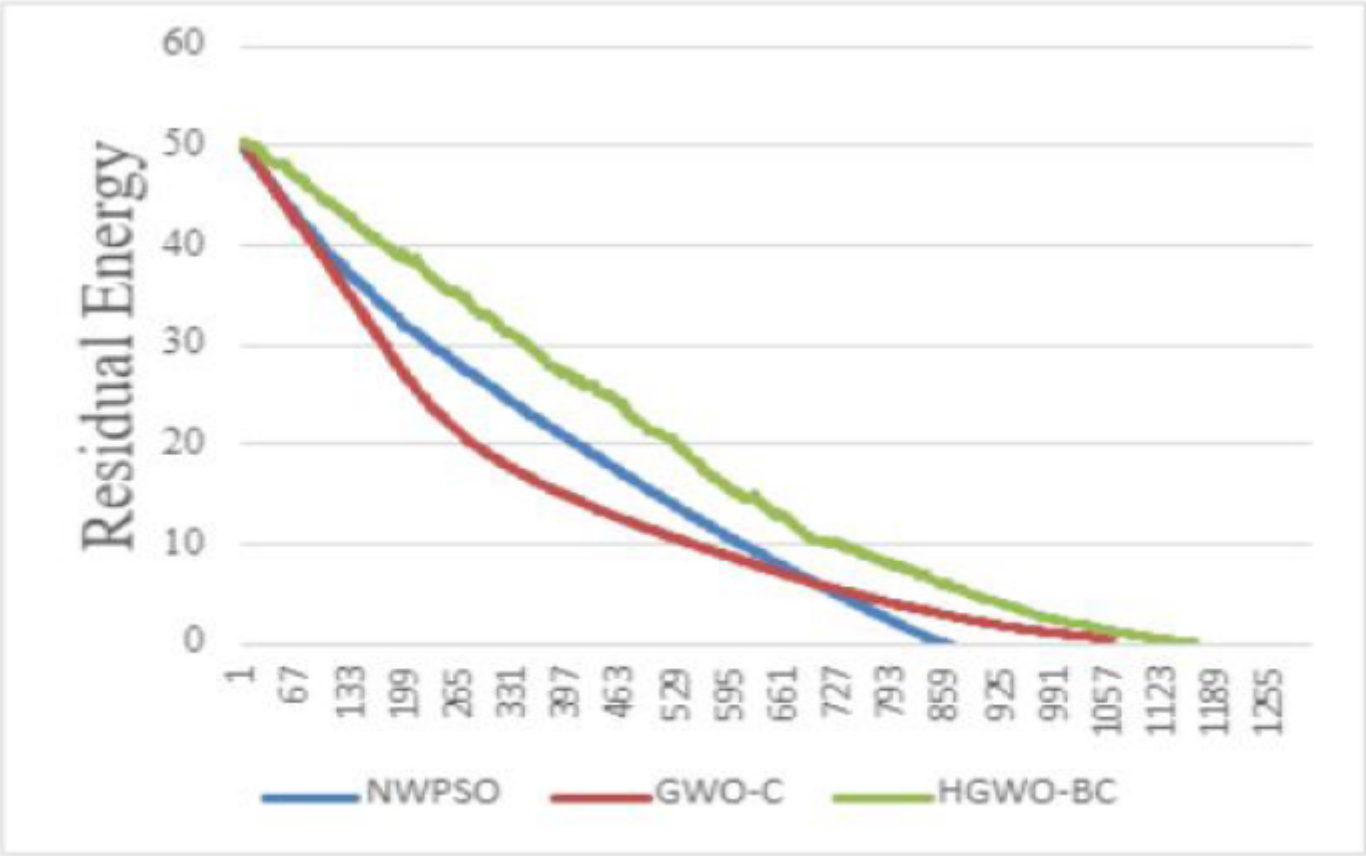

Figure 11

Comparison of HGWO-BC's residual energy when CS is at the outside.

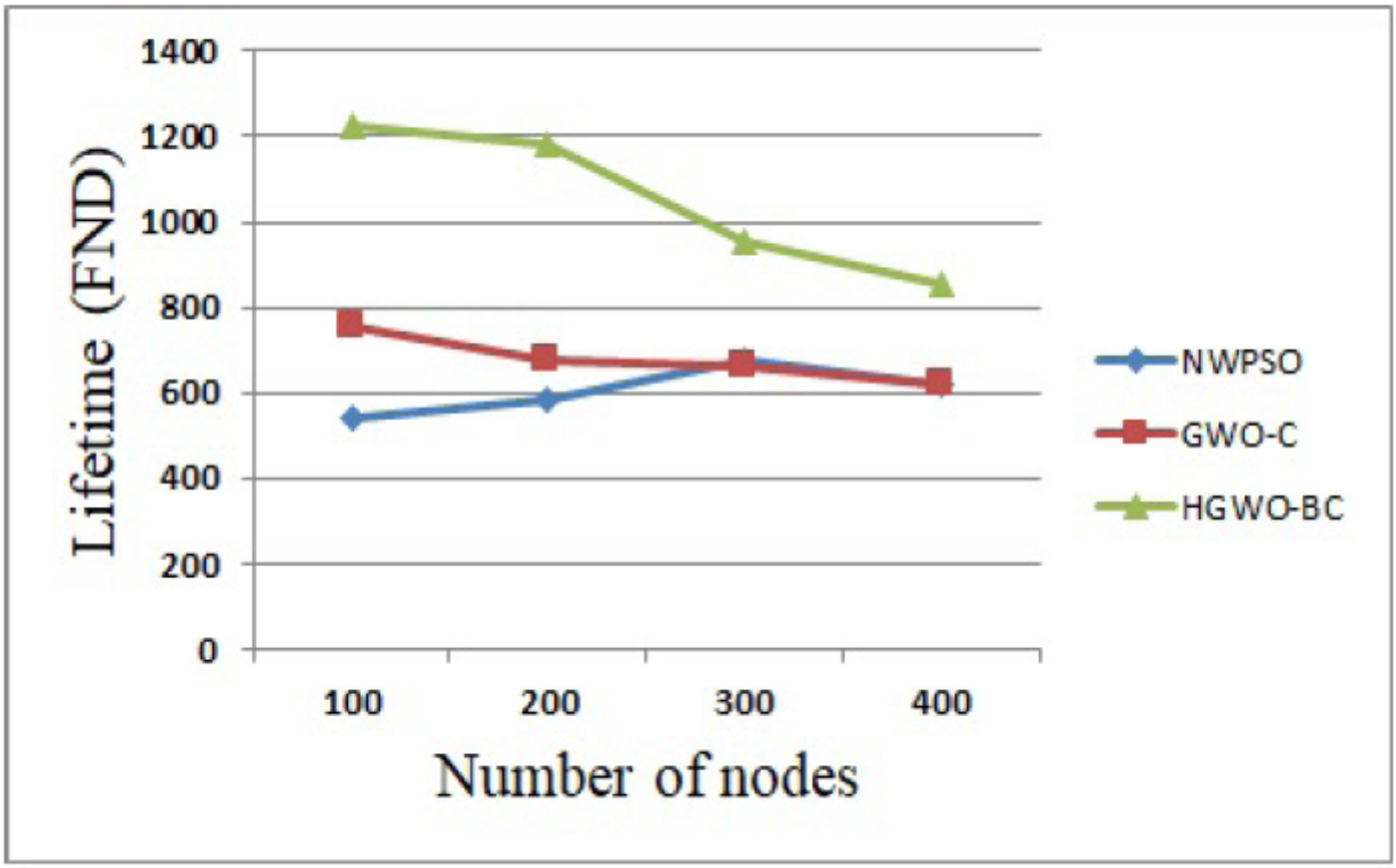

Figure 12

Comparison of HGWO-BC's network life-time with di erent nodes

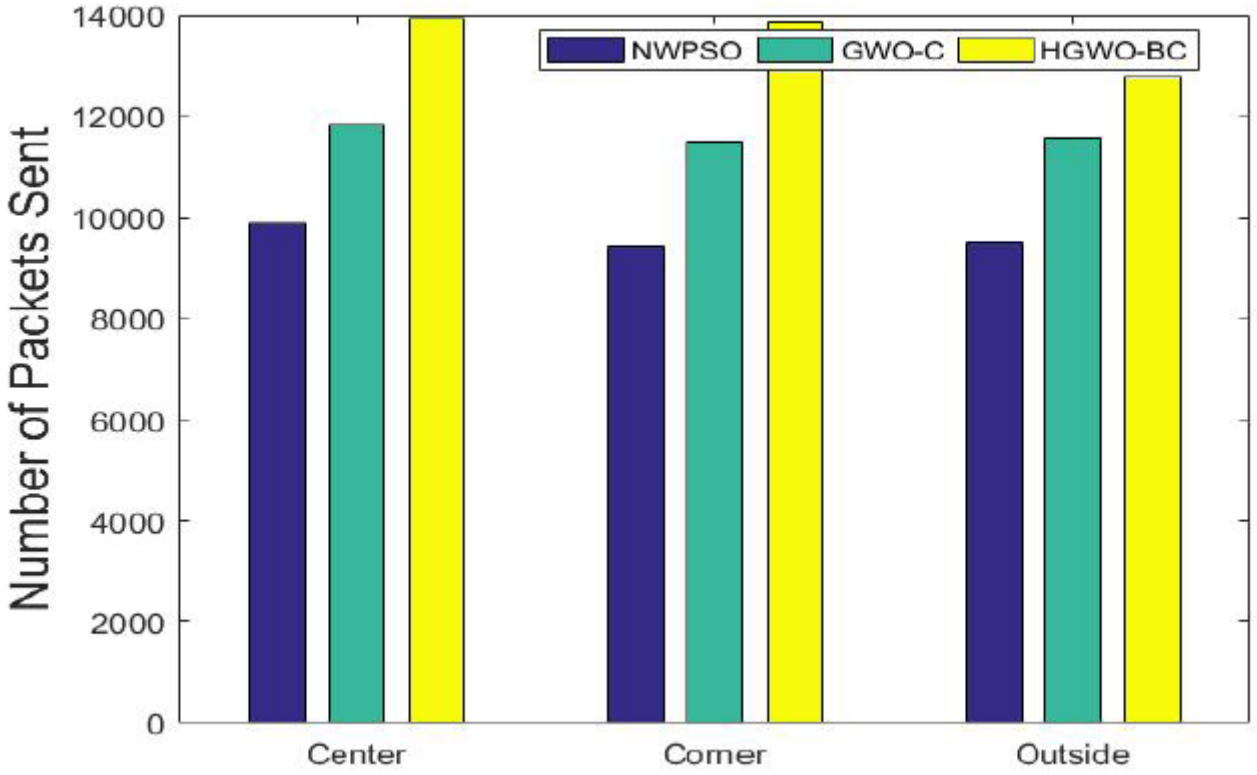

Figure 13

Comparison of HGWO-BC's network throughput with di erent CS sites.

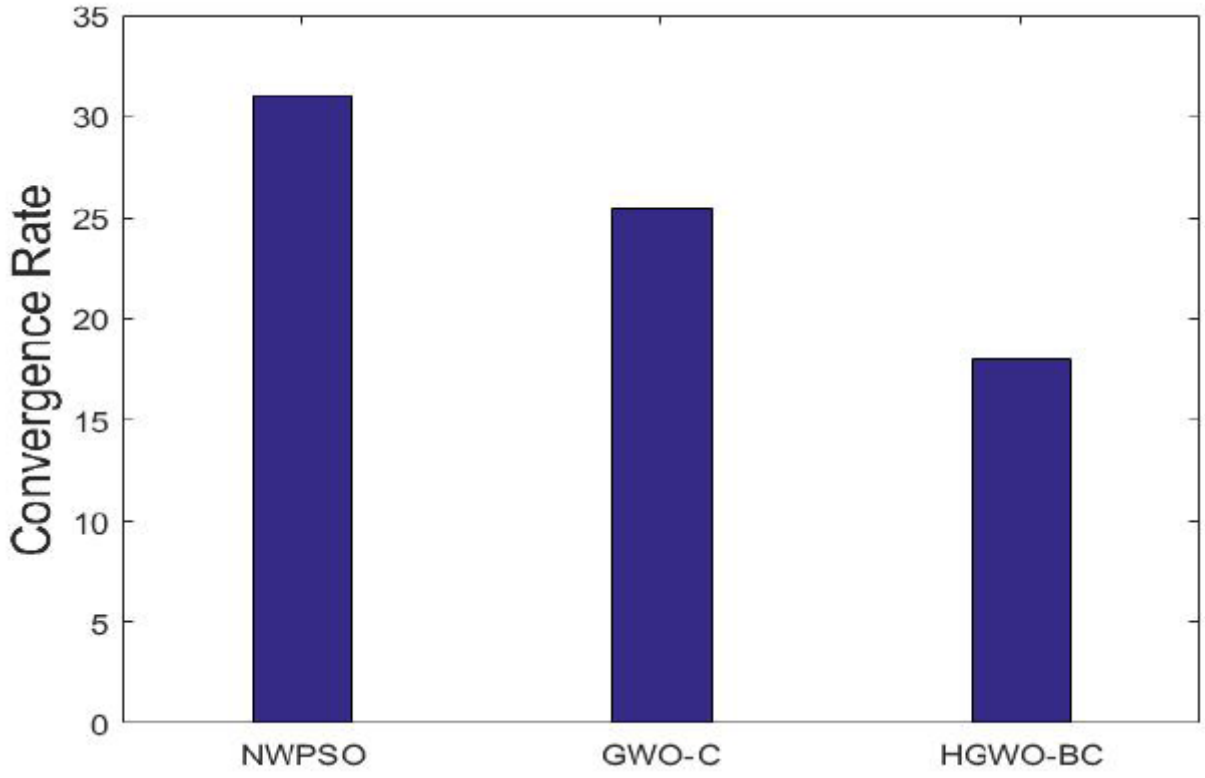

Figure 14

Comparison of HGWO-BC's convergence rate with state-of-arts.