Prediction and Feedback Assisted Evolutionary Algorithms for Scheduling Urban Traffic Signals

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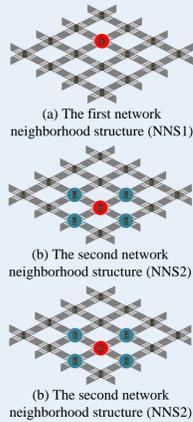澳門科技大學 MACAU UNIVERSITY OF SCIENCE AND TECHNOLOGY

創新工程學院 Faculty of Innovation Engineering

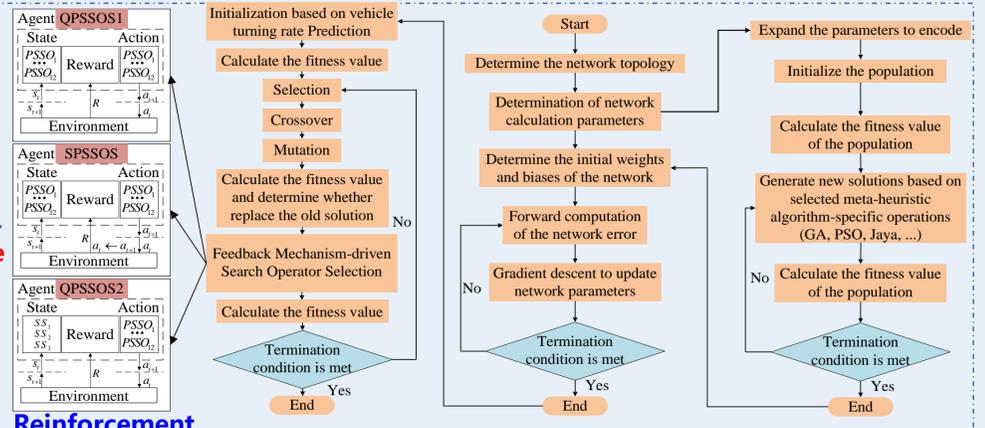# Research Direction and Methods

Research Direction

Urban Traffic Signal Control; Intelligent transportation; Meta-heuristics; Artificial Intelligence; Complex Systems Modeling, Optimization and Scheduling; Multi-objective Optimization.
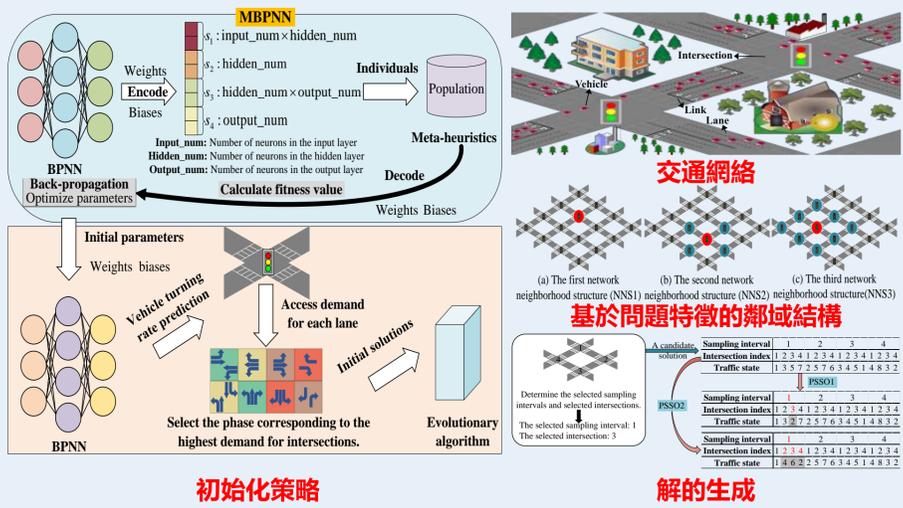
智能協同優化

Problem-specific knowledge **Ensemble** Reinforcement learning algorithm Meta-heuristics Initialization

Representative Work

Representative Results

預測與反饋輔助調度

初始化策略　解的生成

基於問題特徵的鄰域結構

交通網絡

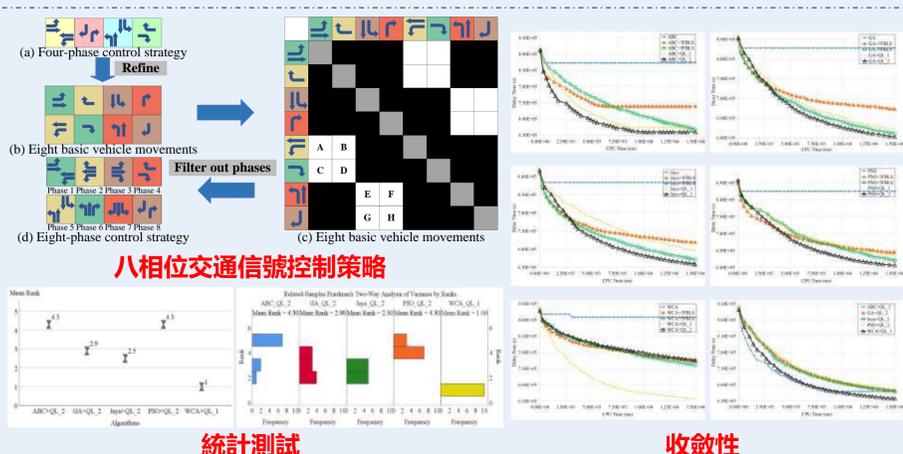多目標城市交通信號調度

Phase 1　Phase 2　Phase 3　Phase 4
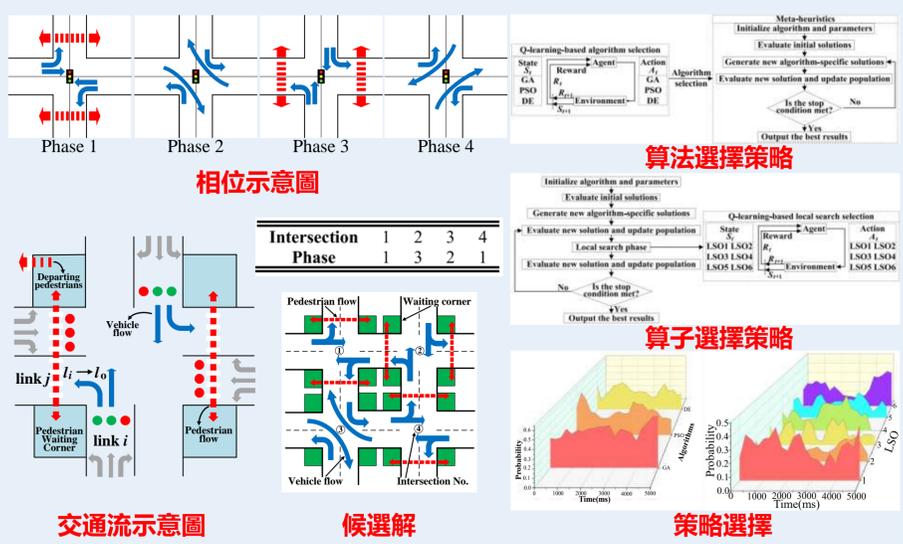
相位示意圖　算法選擇策略

交通流示意圖　候選解　算子選擇策略　策略選擇

複雜八相位交通信號調度

八相位交通信號控制策略

統計測試　收斂性

Participating in Funded Projects

◆ Cooperative swarm intelligence optimization algorithms for scheduling amphibious unmanned surface vehicles group problems under complex scenarios, FDCT, 0023/2025/RIA1.

◆ Learning based collaborative intelligent scheduling and rescheduling for remanufacturing with uncertain, FDCT, 0019/2021/A.

◆ Problem specific knowledge based intelligent scheduling and rescheduling for uncertain remanufacturing, NSFC, 62173356.

◆ USV intelligent collaborative and autonomous task allocation, Zhuhai, PI.

◆ Zhuhai Industry-University-Research Project with Hongkong and Macao, ZH22017002210014PWC.

◆ Guangdong Basic and Applied Basic Research Foundation, Guangdong, 2023A1515011531.

Representative Paper

[1] **Z. Lin, K. Gao**, P. Duan, N. Wu, and P. N. Suganthan, "Prediction and feedback assisted evolutionary algorithms for scheduling urban traffic signals," *IEEE Transactions on Intelligent Transportation Sysyems*, vol. 26, no. 5, pp. 6881-6890, May 2025.(大學特級成果) ((林中杰第一作者，澳門科技大學第一單位，齊魯工業大學第二單位)

Main Contributions:

(1) Three novel prediction and feedback assisted evolutionary algorithms are proposed.

(2) Back-propagation neural networks are integrated with meta-heuristics to predict vehicle steering rates for generating premium initial solutions, while reinforcement learning algorithms like Sarsa are employed to dynamically select twelve problem-specific search operators.

[2] **Z. Lin, K. Gao**, N. Wu, and P. N. Suganthan, "Problem-specific knowledge based multi-objective meta-heuristics combined Q-learning for scheduling urban traffic lights with carbon emissions," *IEEE Transactions on Intelligent Transportation Sysyems*, vol. 25, no. 10, pp. 15053-15064, Oct. 2024. (大學特級成果) ((林中杰第一作者，澳門科技大學第一單位，卡塔爾大學第二單位)

Main Contributions:

(1) A multi-objective urban traffic light scheduling problem model is constructed, simultaneously considering vehicle delays, pedestrian waiting times, and carbon emissions.

(2) Q-learning-based algorithm selection strategies and Q-learning-based local search selection strategies are designed to seek a Pareto-optimal balance among multiple conflicting objectives.

[3] **Z. Lin, K. Gao**, P. Duan, N. Wu, and P. N. Suganthan, "Scheduling eight-phase urban traffic light problems via ensemble meta-heuristics and Q-learning based local search," *IEEE Transactions on Intelligent Transportation Sysyems*, vol. 24, no. 12, pp. 14415–14426, Dec. 2023. (大學特級成果) ((林中杰第一作者，澳門科技大學第一單位，卡塔爾大學第二單位)

Main Contributions:

(1) The traditional four-phase model is extended into a complex eight-phase urban traffic light scheduling model.

(2) A hybrid framework integrating meta-heuristics with Q-learning is proposed, which accelerates convergence through five problem-feature-based local search operators.

Honors/Awards

◆ 2024年第七屆智能優化與調度學術會議**優秀論文**二等獎

◆ 2023年獲得**霍英東基金會獎學金**

◆ 2021年獲得**中國銀行澳門分行獎學金**

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