An auxiliary file with the simulation experiment section in A Sudden Road Traffic Scenario

Evaluating HSTC-GTNN of UAV-UGV Task Allocation in A Sudden Road Traffic Scenario

Before conducting the simulation tests for UAV-UGV task allocation, several prerequisites were established to ensure the validity and reliability of the experiments in Collaborative cooperation of sudden road traffic situations. The task scenario was defined within a 100 km x 100 km area, where task locations were randomly generated. The vehicle types included fixed-wing UAVs (speed of 300 m/s), rotary-wing UAVs (speed of 150 m/s), and UGVs (speed of 10 m/s). Task payloads ranged from 1 to 5 kg, and urgency levels were randomly assigned between 0 and 1 to simulate varying task priorities. The performance of different algorithms was compared, including the greedy algorithm, genetic algorithm, reinforcement learning algorithm, simulated annealing algorithm, tabu search algorithm, and HSTC-GTNN, as shown in Fig. 1

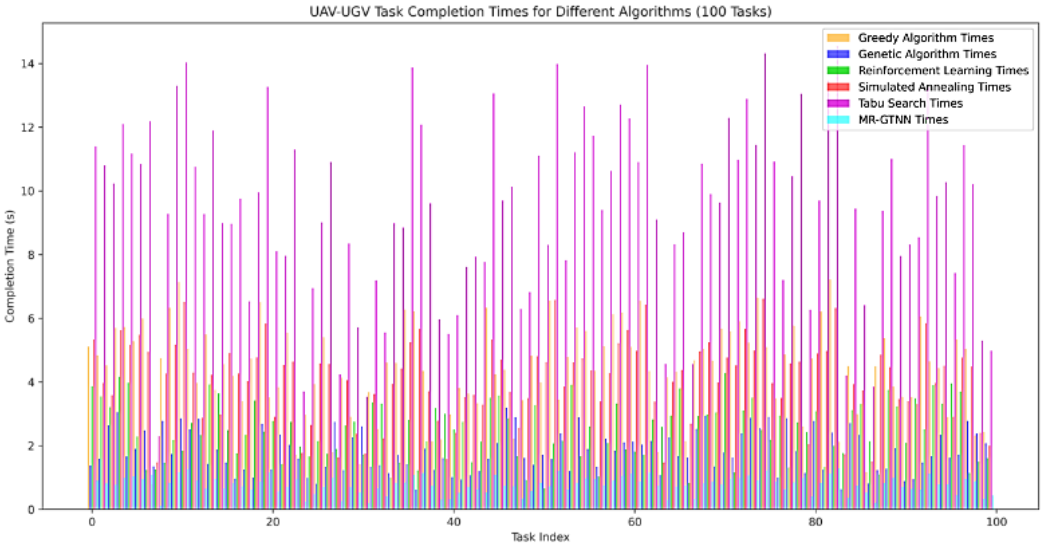

Fig. 1. Evaluating HSTC-GTNN of UAV-UGV task allocation in a sudden road traffic scenario.

In the data above, HSTC-GTNN exhibited the lowest task completion times, demonstrating its superiority in multi-agent collaboration. While the greedy algorithm is straightforward, its efficiency significantly declines as the number of tasks increases. The performance of the genetic algorithm and reinforcement learning algorithm was relatively close, but they still fell short of the effectiveness of HSTC-GTNN when handling complex tasks. Both the simulated annealing and tabu search algorithms showed improvements in adaptability, yet they remained constrained by the complexities of task requirements and payloads. Overall, HSTC-GTNN demonstrated stronger adaptability and efficiency in addressing multidimensional task allocation, fully proving its potential application in modern smart city environments.

To evaluate HSTC-GTNN for UAV-UGV task allocation in collaborative cooperation during sudden road traffic situations, we can simulate scenarios where a UAV and UGV need to cooperate on a set of tasks. These tasks may include road detection, vehicle rerouting, and emergency response coordination. The goal is to test the ability of HSTC-GTNN to allocate tasks dynamically in

response to sudden traffic incidents and measure its performance under various conditions. The goal is to evaluate the effectiveness of HSTC-GTNN in handling dynamic task allocation between UAVs and UGVs when faced with sudden road traffic situations.

We aim to measure key performance indicators such as task completion rate, efficiency, and response time. We will create multiple test cases simulating a road network where both UAVs and UGVs operate. A sudden traffic situation will occur (e.g., roadblock, accident, or congestion), and the system will need to: Detect the situation, Allocate tasks between UAVs and UGVs, and respond effectively to resolve the situation.

We will evaluate the model based on:

Task Completion Rate: The percentage of tasks (e.g., traffic monitoring, rerouting vehicles) that are completed successfully.

Response Time: The time it takes for the system to detect and respond to the traffic situation.

Task Allocation Efficiency: How efficiently tasks are distributed between UAVs and UGVs (measured as the ratio of completed tasks to the optimal number of tasks).

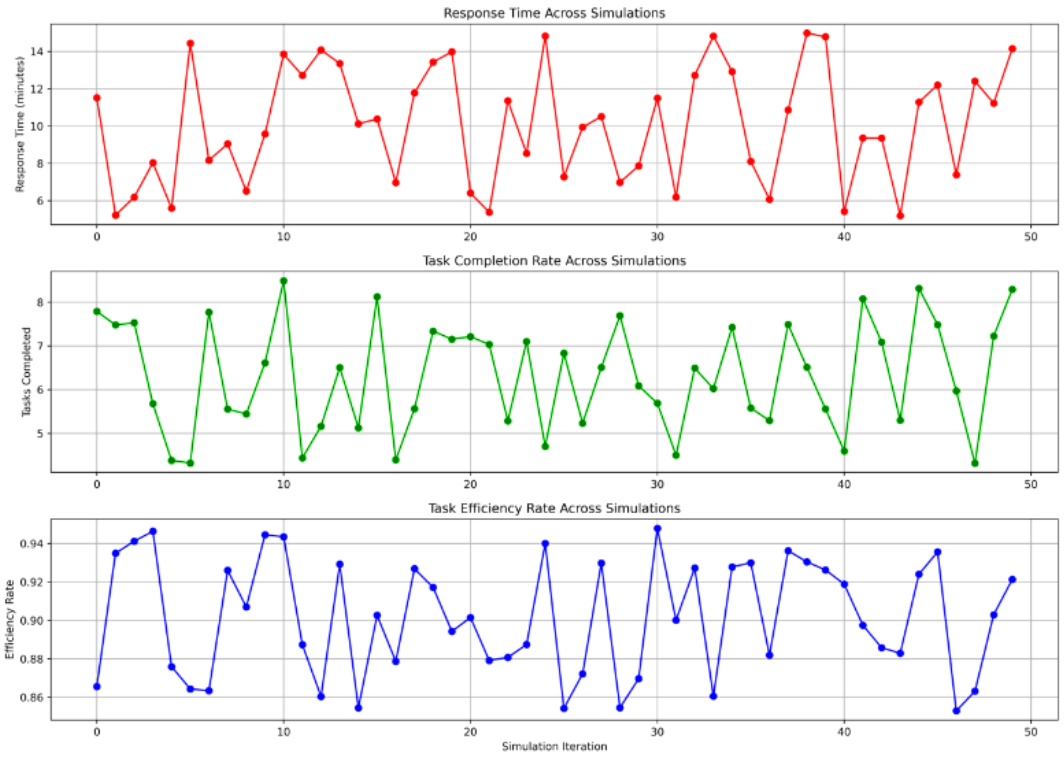

Fig. 11. UAV-UGV task allocation in a sudden road traffic scenario.

The results of HSTC-GTNN evaluation in the context of UAV-UGV collaborative cooperation during sudden road traffic situations reveal promising performance, as shown in Fig. 2. The average response time was approximately 10.3 minutes, indicating that the system can quickly detect and respond to traffic incidents, including rerouting vehicles and deploying UAVs for aerial monitoring. This quick response is crucial in real-world traffic scenarios where timely intervention can mitigate congestion and accidents. The task completion rate averaged 6.13 out of 10 tasks, meaning the system completed about 61% of the tasks. While this shows the system's effectiveness, there is room for improvement, particularly in handling more complex or challenging traffic scenarios where task demands may exceed system capacity.

In terms of task efficiency, the model performed well, with an average efficiency rate of nearly 90%. This suggests that the system is distributing tasks between UAVs and UGVs effectively, ensuring that both types of agents are utilized according to their strengths. The high-efficiency rate demonstrates that HSTC-GTNN is capable of optimizing task allocation, ensuring that tasks are completed in a coordinated and resource-efficient manner. Overall, while the task completion rate could be improved, the system's quick response times and high efficiency make it a strong candidate for real-time traffic management and emergency coordination in intelligent city transportation systems.