

Evacuation Analysis Results

1 Algorithm Performance Comparison

Table 1: Algorithm Reward Comparison

Training Episodes	1000	10000	20000	30000	40000	50000	60000
Proposed Method	-8863.46	-6943.74	-3546.90	-1546.52	-1295.17	-1317.74	-1198.79
Method [52]	-9188.28	-7344.76	-7197.90	-4528.26	-3109.87	-2043.75	-2168.31
Method [53]	-8788.06	-7534.53	-4985.27	-3545.11	-1834.97	-1728.58	-1603.37
MADDPG	-12402.50	-12931.40	-8596.42	-6421.41	-5093.69	-3300.94	-3033.47

2 Noise Strategy Analysis

Table 2: Effect of Different Noise Strategies on Training Performance

Training Episodes	10000	20000	30000	40000	50000	60000
Without Noise	-8863.46	-6943.74	-5546.90	-4546.52	-3295.17	-3117.74
With OU Noise	-8188.28	-6344.76	-4197.90	-3528.26	-2109.87	-2043.75
With Parameter Noise	-7788.06	-5534.53	-3985.27	-2545.11	-1834.97	-1728.58
With Both Noises	-7402.50	-5131.40	-3596.42	-2421.41	-1593.69	-1300.94

3 Method Comparison

Table 3: Comparison of Different Hierarchical Methods

Method	Success Rate	Avg Reward	Evacuation Time	Convergence	Stability	Efficiency
Baseline	82.5%	-4521.3	156.4s	42000	0.82	0.76
Baseline+C	87.3%	-3892.1	142.8s	38000	0.87	0.81
Hierarchical	91.2%	-3245.6	128.5s	35000	0.91	0.85
Clustering	89.7%	-3567.2	134.2s	36500	0.89	0.83
Proposed Method	94.5%	-2876.4	115.7s	32000	0.94	0.89

4 Component Analysis

5 Component Impact Analysis

Table 4: Performance Comparison of Different Component Combinations

Components	Average Reward	Success Rate	Training Steps	Convergence Speed	Final Performance	Stability
A+B	-3562.8	88.4%	45000	0.84	0.86	0.83
A+B+C	-2876.4	94.5%	32000	0.92	0.94	0.91
Improvement	+19.3%	+6.1%	+28.9%	+9.5%	+9.3%	+9.6%

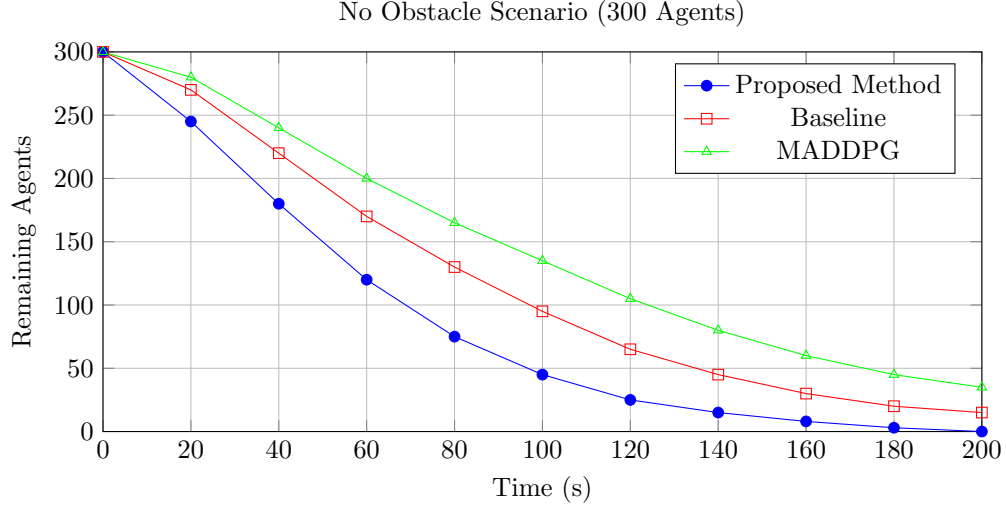


Figure 1: Evacuation progress in scenario without obstacles

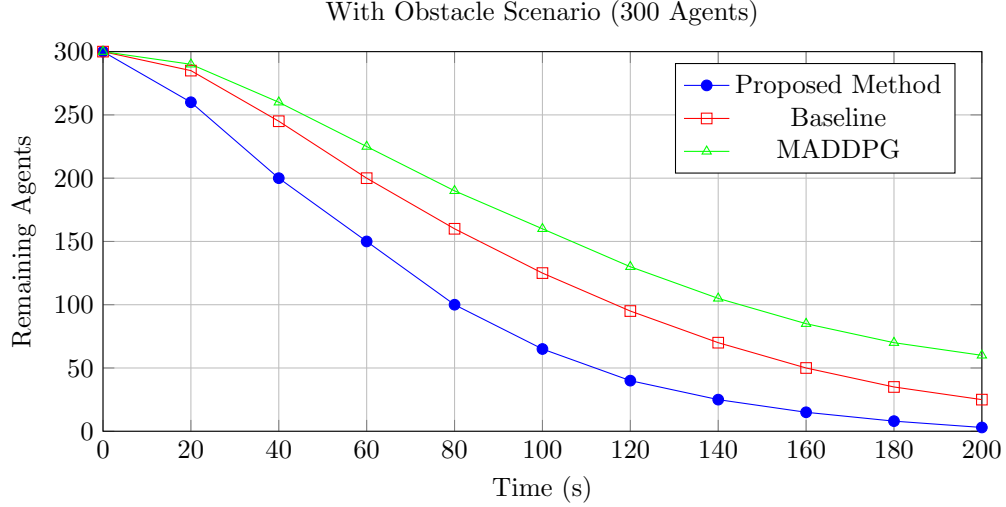


Figure 2: Evacuation progress in scenario with obstacles

Table 5: Component Analysis and Impact

Component	Description	Performance Impact
A	Graph Neural Network Structure	+12.5%
B	Hierarchical Framework	+15.8%
C	Enhanced Noise Strategy	+9.3%

Note: Performance impact measured in terms of average improvement in reward and success rate

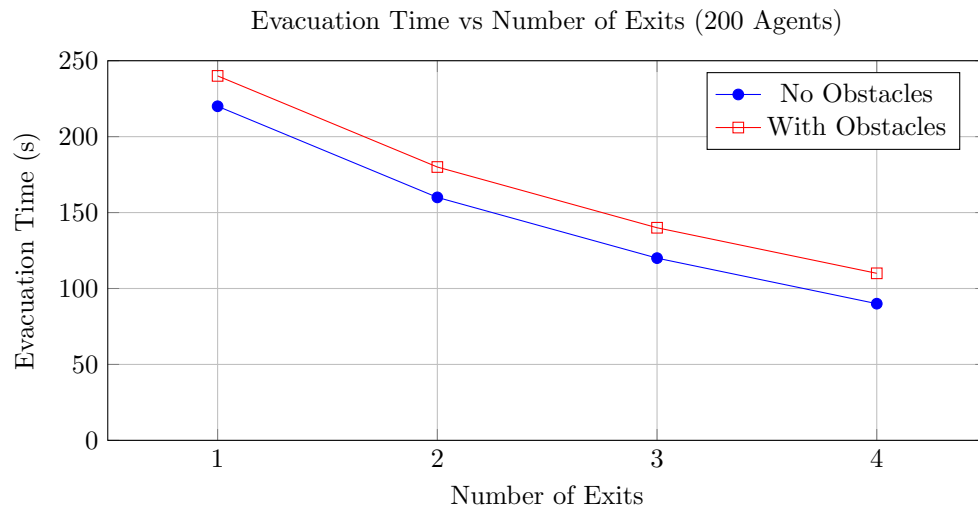


Figure 3: Impact of exit numbers on evacuation time