

I. Supplementary for Convergence and Performance

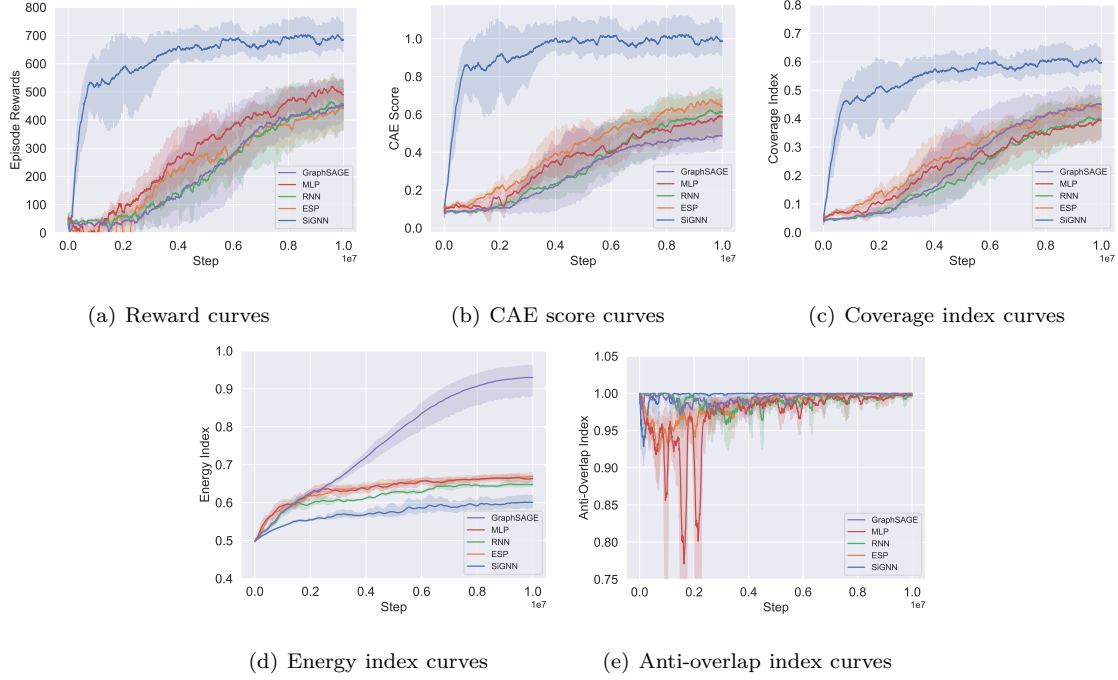


Fig. 1. The curves of rewards, CAE scores and corresponding indexes for scenario with global observation.

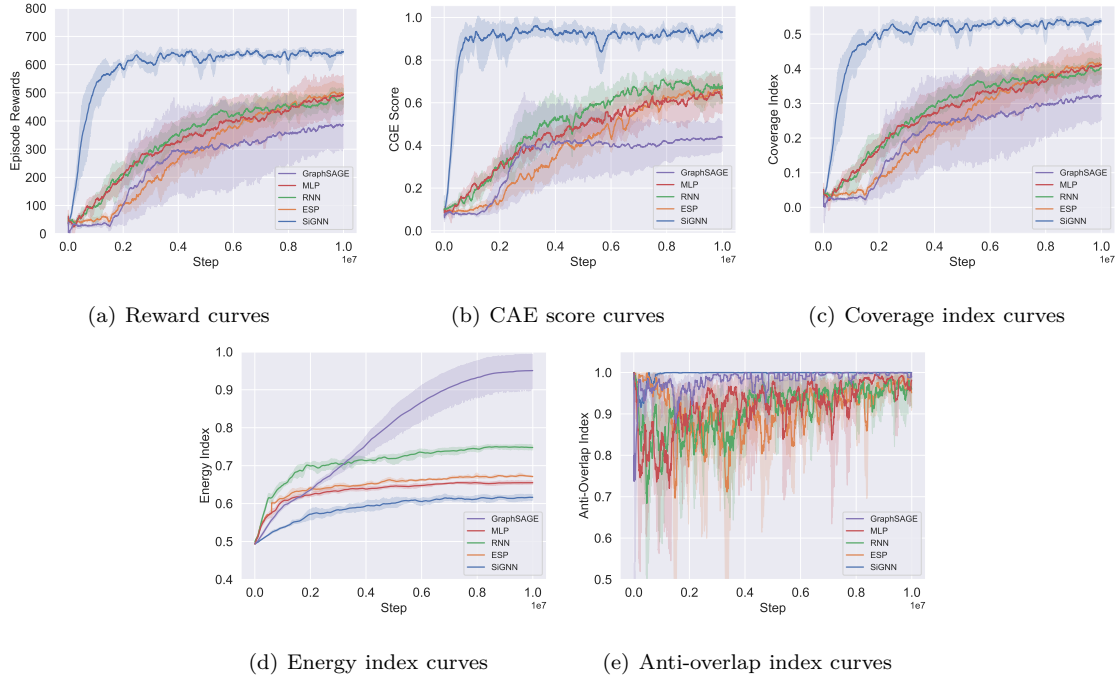


Fig. 2. The curves of rewards, CAE scores and corresponding indexes for scenario with $R_{\text{obs}} = 70$.

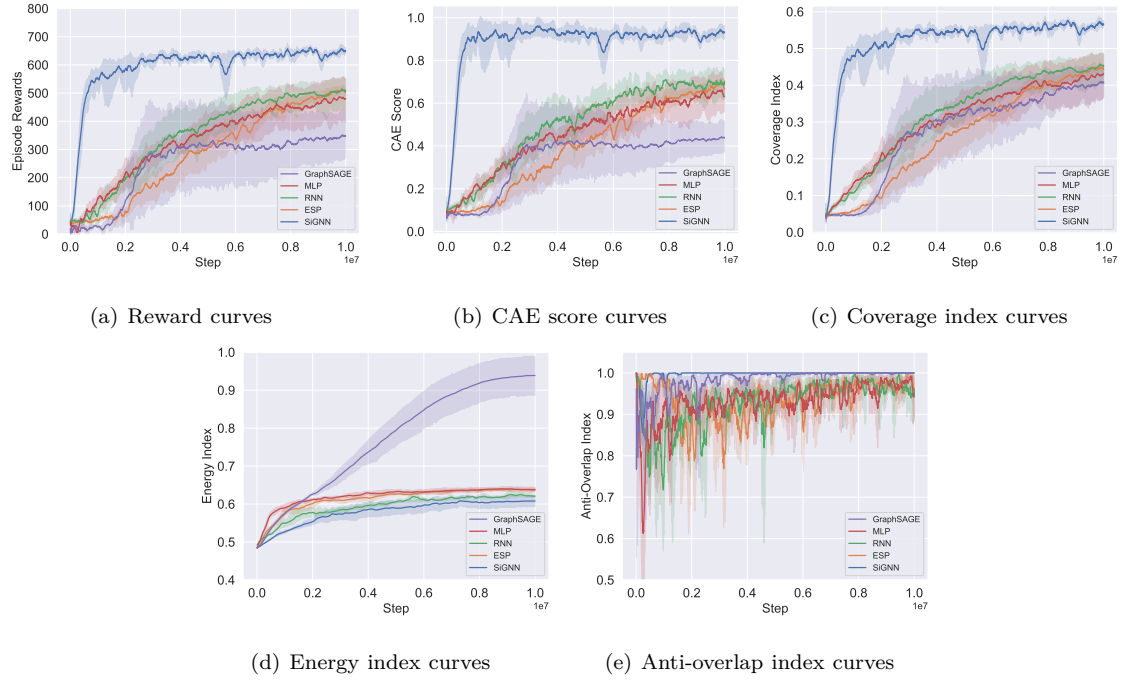


Fig. 3. The curves of rewards, CAE scores and corresponding indexes for scenario with $R_{\text{obs}} = 50$.

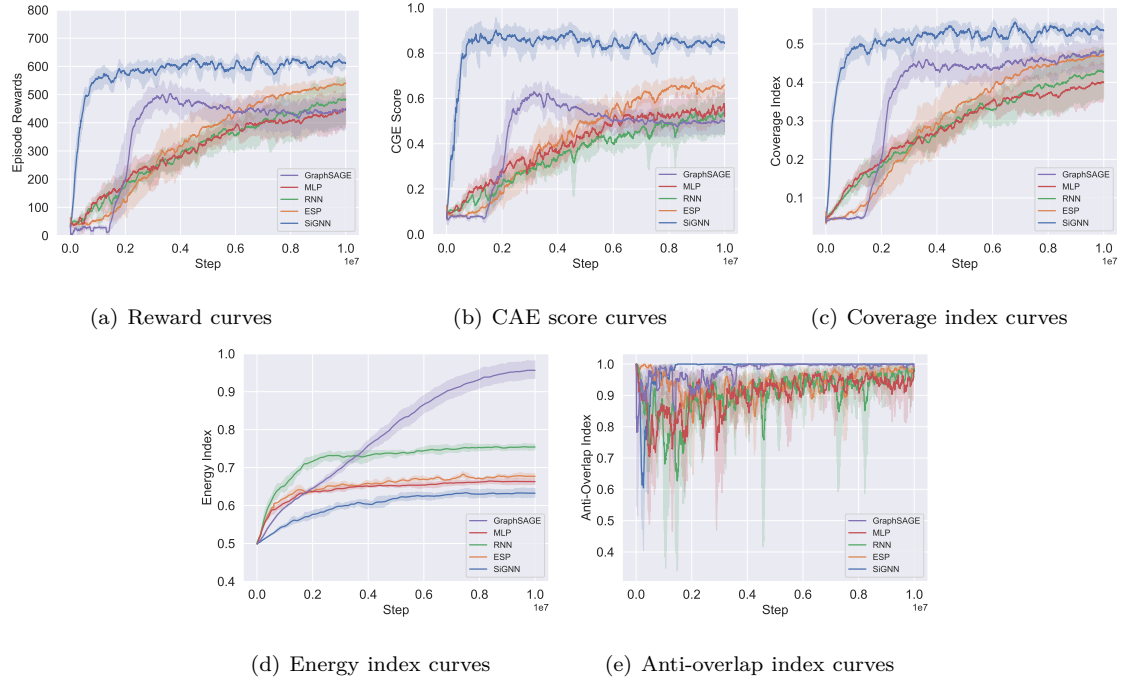


Fig. 4. The curves of rewards, CAE scores and corresponding indexes for scenario with $R_{\text{obs}} = 30$.

II. Supplementary for Comparison among Learning-based Approaches

TABLE I
Metric Performance under Global Observation

Algorithm	CAE Score	Coverage Index	Energy Index	Anti-Overlap Index
GraphSAGE	0.4861 ± 0.1105	0.4495 ± 0.0716	0.9299 ± 0.0543	0.3998 ± 0.0979
MLP	0.5866 ± 0.1165	0.3921 ± 0.0759	0.6632 ± 0.0111	0.9975 ± 0.0027
RNN	0.6129 ± 0.1552	0.3998 ± 0.0979	0.6478 ± 0.0084	0.9972 ± 0.0027
ESP	0.6428 ± 0.0739	0.4332 ± 0.0488	0.6689 ± 0.0119	0.9883 ± 0.0028
SiGNN	0.9852 ± 0.1104	0.5947 ± 0.0563	0.6008 ± 0.0209	0.9999 ± 0.0001

TABLE II
Metric Performance under $R_{\text{obs}} = 70$

Algorithm	CAE Score	Coverage Index	Energy Index	Anti-Overlap Index
GraphSAGE	0.4379 ± 0.0893	0.3220 ± 0.0893	0.9505 ± 0.0579	0.9895 ± 0.0235
MLP	0.6213 ± 0.0936	0.4121 ± 0.0741	0.6551 ± 0.0054	0.9816 ± 0.0257
RNN	0.6817 ± 0.0810	0.4032 ± 0.0355	0.7479 ± 0.0079	0.9602 ± 0.0498
ESP	0.6363 ± 0.0471	0.4024 ± 0.0355	0.6713 ± 0.0017	0.9511 ± 0.0490
SiGNN	0.8728 ± 0.0376	0.5380 ± 0.0078	0.6164 ± 0.0097	1.0000 ± 0.0000

TABLE III
Metric Performance under $R_{\text{obs}} = 50$

Algorithm	CAE Score	Coverage Index	Energy Index	Anti-Overlap Index
GraphSAGE	0.4379 ± 0.0893	0.4065 ± 0.0537	0.9387 ± 0.0645	0.9985 ± 0.0015
MLP	0.6313 ± 0.0936	0.4304 ± 0.0752	0.6382 ± 0.0084	0.9420 ± 0.0673
RNN	0.7017 ± 0.0810	0.4529 ± 0.0528	0.6208 ± 0.0047	0.9635 ± 0.0528
ESP	0.6663 ± 0.0471	0.4439 ± 0.0142	0.6373 ± 0.0053	0.9572 ± 0.0691
SiGNN	0.9313 ± 0.0376	0.5655 ± 0.0109	0.6078 ± 0.0181	1.0000 ± 0.0000

TABLE IV
Metric Performance under $R_{\text{obs}} = 30$

Algorithm	CAE Score	Coverage Index	Energy Index	Anti-Overlap Index
GraphSAGE	0.4997 ± 0.0619	0.4802 ± 0.0523	0.9562 ± 0.0274	0.9932 ± 0.0150
MLP	0.5201 ± 0.0887	0.4001 ± 0.0613	0.6631 ± 0.0090	0.9794 ± 0.0245
RNN	0.5340 ± 0.1114	0.4269 ± 0.0794	0.7542 ± 0.0097	0.9760 ± 0.0218
ESP	0.6587 ± 0.0442	0.4713 ± 0.0287	0.6769 ± 0.0085	0.9891 ± 0.0157
SiGNN	0.8444 ± 0.0286	0.5340 ± 0.0197	0.6324 ± 0.0143	1.0000 ± 0.0000

III. Supplementary for Scalability

TABLE V
Scalability Performance under Partial Observation $R_{\text{obs}} = 70$

Number	Steps	EGNN	MLP	RNN	ESP	Graphsage
5	300k	607.38 \pm 14.71	293.33 \pm 25.42	311.68 \pm 44.21	208.59 \pm 39.30	268.24 \pm 38.50
	1000k	667.62 \pm 23.57	474.58 \pm 42.24	498.68 \pm 39.93	507.34 \pm 34.14	394.69 \pm 54.24
10	300k	424.53 \pm 19.85	7.83 \pm 38.26	37.69 \pm 38.89	7.57 \pm 31.23	−36.17 \pm 43.52
	1000k	488.82 \pm 24.14	95.46 \pm 55.96	101.78 \pm 42.95	86.08 \pm 67.34	−335.17 \pm 88.26
15	300k	246.75 \pm 27.47	−245.42 \pm 32.58	−310.77 \pm 52.13	−92.52 \pm 35.62	−256.23 \pm 67.32
	1000k	268.82 \pm 35.52	−81.04 \pm 52.62	26.52 \pm 58.76	24.56 \pm 67.73	−491.34 \pm 74.36
20	300k	35.77 \pm 63.15	−452.94 \pm 44.52	−295.15 \pm 38.46	−378.42 \pm 82.74	−378.18 \pm 62.52
	1000k	141.87 \pm 67.32	−623.17 \pm 50.70	−56.64 \pm 62.10	−174.42 \pm 104.42	−876.13 \pm 124.33

TABLE VI
Scalability Performance under Partial Observation $R_{\text{obs}} = 50$

Number	Steps	EGNN	MLP	RNN	ESP	Graphsage
5	300k	619.76 \pm 26.43	286.22 \pm 32.60	331.68 \pm 44.21	198.59 \pm 29.30	288.24 \pm 38.50
	1000k	649.61 \pm 26.11	489.38 \pm 52.24	517.68 \pm 29.90	501.34 \pm 34.14	364.69 \pm 54.24
10	300k	378.06 \pm 23.45	39.84 \pm 38.26	53.41 \pm 38.89	−6.62 \pm 51.92	−6.57 \pm 54.14
	1000k	462.59 \pm 33.42	75.71 \pm 55.96	90.77 \pm 49.17	83.47 \pm 48.53	−235.17 \pm 78.42
15	300k	235.31 \pm 31.50	−202.66 \pm 41.68	−214.55 \pm 44.50	−104.39 \pm 67.43	−144.95 \pm 87.31
	1000k	226.83 \pm 41.22	−58.44 \pm 60.13	43.01 \pm 69.55	55.68 \pm 41.77	−526.73 \pm 93.47
20	300k	50.68 \pm 37.32	−322.46 \pm 84.61	−336.59 \pm 52.36	−426.25 \pm 76.15	−558.18 \pm 95.12
	1000k	122.14 \pm 57.21	−378.82 \pm 76.32	−78.14 \pm 82.23	−118.54 \pm 45.50	−943.23 \pm 154.33

TABLE VII
Scalability Performance under Partial Observation $R_{\text{obs}} = 30$

Number	Steps	EGNN	MLP	RNN	ESP	Graphsage
5	300k	593.12 \pm 35.78	254.56 \pm 53.27	243.58 \pm 43.12	231.88 \pm 78.74	488.32 \pm 57.96
	1000k	615.26 \pm 25.73	453.71 \pm 51.92	472.88 \pm 40.56	543.24 \pm 43.25	439.74 \pm 75.27
10	300k	394.88 \pm 32.12	43.83 \pm 47.59	49.99 \pm 39.24	34.98 \pm 62.81	−62.13 \pm 53.34
	1000k	411.17 \pm 28.45	101.43 \pm 66.78	117.37 \pm 82.61	66.57 \pm 37.48	−171.87 \pm 69.14
15	300k	160.62 \pm 30.67	−215.73 \pm 50.45	−112.4 \pm 45.12	−154.59 \pm 68.34	−96.49 \pm 58.23
	1000k	259.82 \pm 27.54	−141.24 \pm 59.87	20.05 \pm 70.29	23.09 \pm 40.12	−486.23 \pm 74.36
20	300k	70.93 \pm 46.78	−357.58 \pm 45.21	−278.35 \pm 53.87	−336.45 \pm 55.34	−376.38 \pm 62.78
	1000k	125.62 \pm 29.45	−288.76 \pm 51.34	−16.24 \pm 61.25	−78.34 \pm 86.12	−683.23 \pm 73.29