

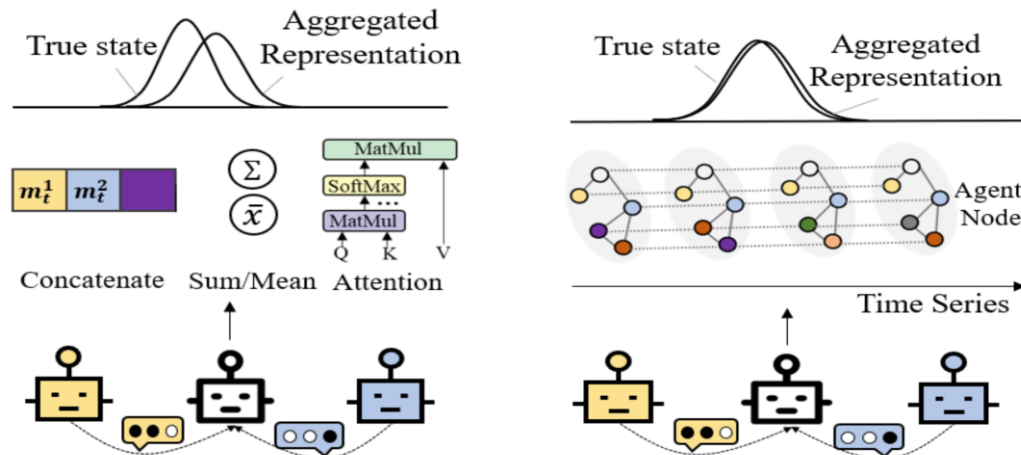
Spatial-Temporal Clues Based Interactive Message Aggregation for Multi-Agent Collaboration

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Problems & Ideas

- Problems of conventional multi-agent communication approaches:
 - In partially observable environments, message aggregation is a key part of multi-agent information sharing.
 - Existing interactive message aggregation approaches often face limitations in accurately measuring the importance of multi-source messages and determining the priority of relevant ones.
- Ideas: A spatial-temporal clues based message aggregation model that enhances multi-agent collaboration jointly leverages topological and sequential features for holistic scene understanding.



Left: Existing methods can rapidly merge received messages but struggle to accurately assess the importance and determine priority. Right: Our method integrates spatial clues from interaction graph nodes with temporal clues across different time steps, enabling the aggregated messages to approximate the true state.

Main Contributions

- Contributions:
 - A spatial aggregation module that extracts the topological features of the nodes in the interaction graph to evaluate the importance of the multi-source messages;
 - A temporal aggregation module for integrating historical interactive feature, which improves the integrity of the aggregation and improves sample utilization;
 - An aggregation representation constraint, which make the final aggregation representation approximate the global scene state.

METHOD	8 - 4p - 3f - s3		11 - 6p - 4f - s3		15 - 8p - 5f - s3		20 - 10p - 6f - s3	
	mean return	AEL	mean return	AEL	mean return	AEL	mean return	AEL
SARNET	0.67±0.33	22.53	0.57±0.19	24.88	0.95±0.11	15.48	0.75±0.22	21.90
MAGIC	1.00±0.00	6.73	1.00±0.00	9.23	0.37±0.23	25.00	0.07±0.11	25.00
MASIA	0.99±0.02	6.65	1.00±0.00	9.11	0.98±0.07	14.23	0.92±0.14	19.13
OURS	1.00±0.00	6.39	1.00±0.00	8.48	0.99±0.04	12.06	0.95±0.08	18.55

METHOD	N=3		N=4		N=5		N=6	
	mean return	DIST	mean return	DIST	mean return	DIST	mean return	DIST
SARNET	-0.49±0.065	0.18	-0.45±0.008	0.19	-0.42±0.094	0.29	-1.02±0.087	0.38
MAGIC	-0.48±0.077	0.084	-0.51±0.078	0.22	-0.38±0.051	0.24	-0.52±0.059	0.31
MASIA	-0.45±0.044	0.078	-0.48±0.033	0.082	-0.41±0.021	0.93	-0.51±0.045	0.19
OURS	-0.44±0.034	0.040	-0.42±0.032	0.086	-0.37±0.024	0.12	-0.51±0.043	0.16

Top: Comparison results on LBF. Notation: 8-4p-3f-s3 denotes 8*8 grid, 4 players, 3 food, 3 sight. AEL: average episode length; Bottom: Cooperative Navigation results for 3-6 agents. Results show mean return (cumulative reward) and DIST (total agent-landmark distance), reported as mean \pm std over 10k trials.