TopoLogic: An Interpretable Pipeline for Lane Topology Reasoning on Driving Scenes

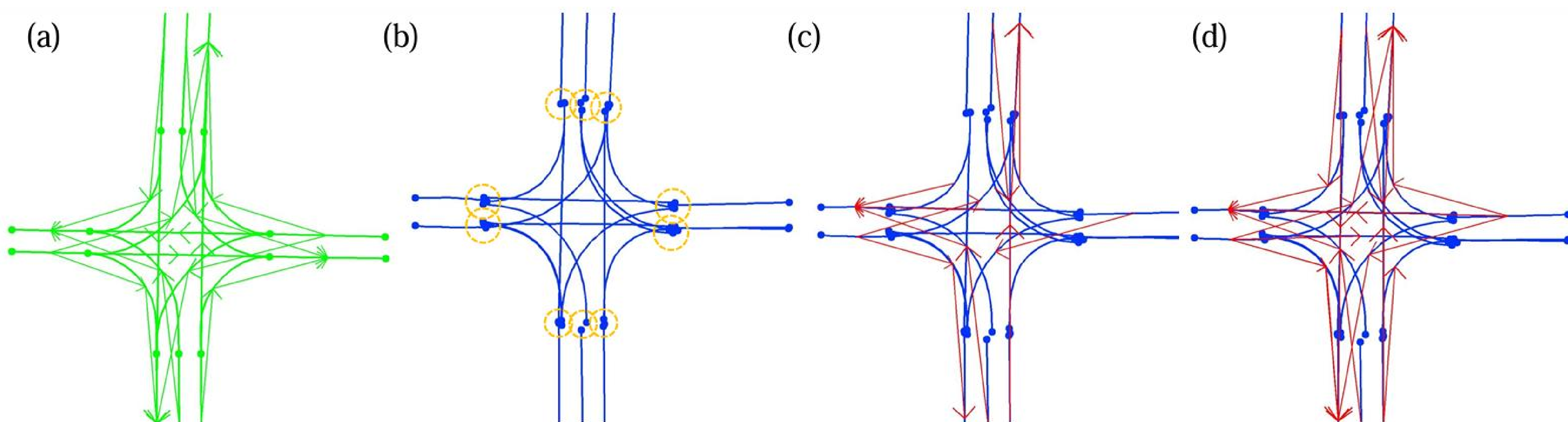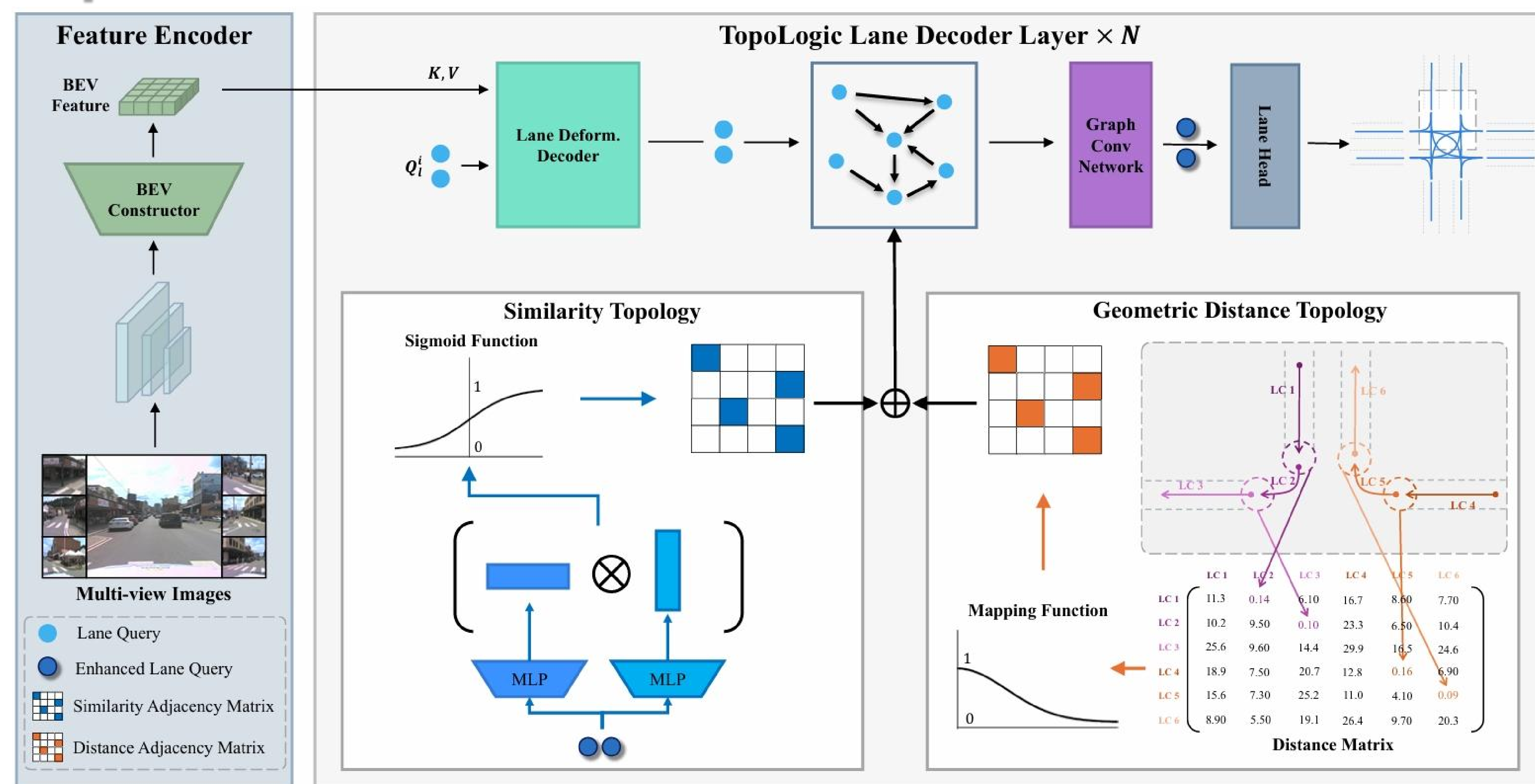Yanping Fu, Wenbin Liao, Xinyuan Liu, Hang Xu, Yike Ma, Yucheng Zhang, Feng Dai

Motivation

1. Slightly shifted endpoints: Lanes may be erroneously classified by MLP as disconnected, as Figure (c).

2. Geometric distance method: Lane topology reasoning is significantly improved, as Figure (d).

Pipeline

3. Lane Geometric Distance Topology: Consist of lane geometric distance matrix and distance to topology mapping function.

$$l_0, \ldots, l_{n-1} = \text{LaneHead}(Q_l^i)$$

$$d_{ij} = \mid l_i^{end} - l_j^{start} \mid$$

$$D = \{d_{ij} \mid i, j = 0 \ldots n - 1\}$$

$$f_{ours} = e^{-\frac{x^\alpha}{\lambda \cdot \sigma}}$$

Experiments

OpenLane-V2 Dataset

Data	Method	SDMap	$DET_l \uparrow$	$DET_t \uparrow$	v1.0.0			v2.1.0		
					$TOP_{ll} \uparrow$	$TOP_{lt} \uparrow$	$OLS \uparrow$	$TOP_{ll} \uparrow$	$TOP_{lt} \uparrow$	$OLS \uparrow$
subset_A	STSU	×	12.7	43.0	0.5	15.1	25.4	2.9	19.8	29.3
	VectorMapNet	×	11.1	41.7	0.4	5.9	20.8	2.7	9.2	24.9
	MapTR	×	17.7	43.5	1.1	10.4	26.0	5.9	15.1	31.0
	TopoNet	×	28.6	48.6	4.1	20.8	35.6	10.9	23.8	39.8
	TopoMLP	×	28.3	**50.0**	7.2	22.8	38.2	19.0	23.4	42.2
	TopoLogic	×	**29.9**	47.2	**18.6**	**21.5**	**41.6**	**23.9**	**25.4**	**44.1**
	SMERF	✓	33.4	**48.6**	7.5	23.4	39.4	15.4	25.4	42.9
	TopoLogic	✓	**34.4**	48.3	**23.4**	**24.4**	**45.1**	**28.9**	**28.7**	**47.5**
subset_B	STSU	×	8.2	43.9	0.0	9.4	21.2	-	-	-
	VectorMapNet	×	3.5	49.1	0.0	1.4	16.3	-	-	-
	MapTR	×	15.2	54.0	0.5	6.1	25.2	-	-	-
	TopoNet	×	24.3	55.0	2.5	14.2	33.2	6.7	16.7	36.8
	TopoMLP	×	**26.6**	**58.3**	7.6	**17.8**	38.7	-	-	-
	TopoLogic	×	25.9	54.7	**15.1**	15.1	**39.6**	**21.6**	**17.9**	**42.3**

Qualitative Result