InstaGraM: Instance-level Graph Modeling for Vectorized HD Map Learning

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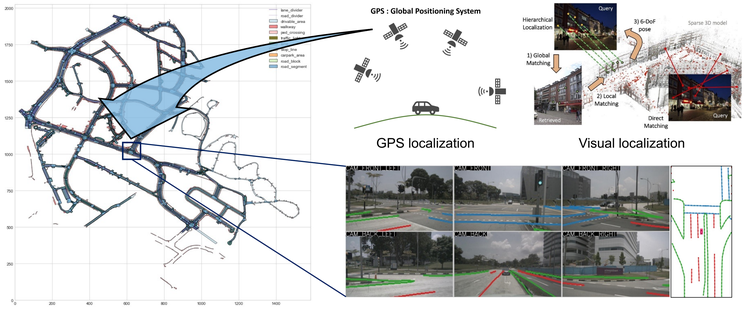
JUNE 18-22, 2023 CVPR VANCOUVER, CANADA

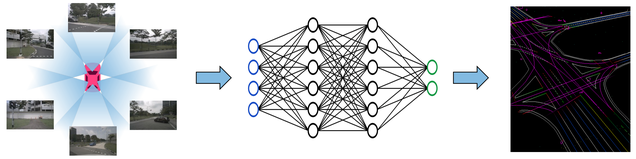
Introduction

- Understanding road scene
  - Traditional approach: offline generated HD map and localization

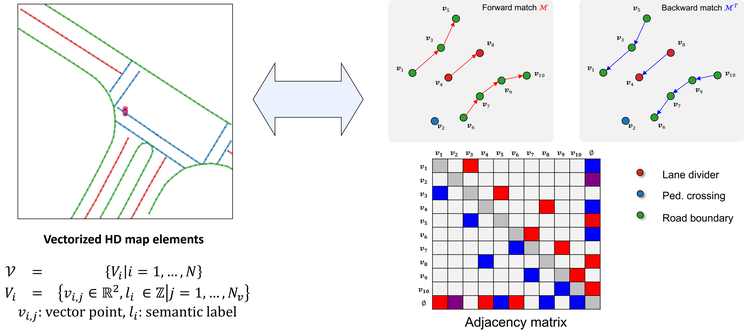


- Limitations
  - Requires offline mapping with multiple high-cost sensors and a large amount of resources
  - Relies on the accuracy of localization
  - Limits autonomous vehicles to operate in geographically restricted (unmapped) area

- Online HD map detection
  - We propose neural network that predicts HD map elements



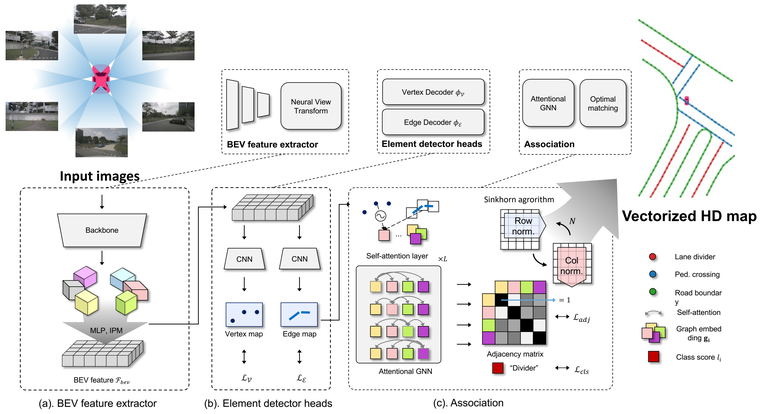
Methodology



$$\mathcal{V} = \{V_i | i = 1, \dots, N\}$$
$$V_i = \{v_{i,j} \in \mathbb{R}^2, l_i \in \mathbb{Z} | j = 1, \dots, N_p\}$$
$v_{i,j}$: vector point, l_i: semantic label

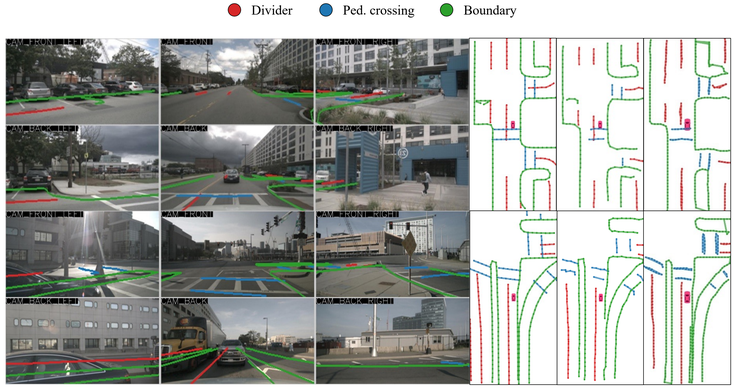
Instance-level Graph Modeling

- Contributions
  - We propose novel graph modeling of vectorized map elements that models geometric, semantic and instance-level information
  - On top of the proposed graph modeling, we present an end-to-end vectorized HD map learning network designed for real-time performance



Proposed architecture

Experimental Results



Method	Modality	Backbone	Epochs	$AP_{divider}$	AP_{ped}	$AP_{boundary}$	mAP	FPS
HDMapNet	L	PP	30	24.1	10.4	37.9	24.1	-
HDMapNet	C+L	EffNet-B0 & PP	30	29.6	16.3	46.7	31.0	-
HDMapNet[1]	C	EffNet-B0	**30**	21.7	14.4	33.0	23.0	0.6
Ours	C	EffNet-B0	**30**	**40.8**	**30.0**	**39.2**	**36.7**	**20.3**
VectorMapNet	L	PP	110	37.6	25.7	38.6	34.0	-
VectorMapNet	C+L	R50 & PP	110	50.5	37.6	47.5	45.2	-
VectorMapNet[2]	C	R50	110	**47.3**	**36.1**	39.3	40.9	3.0
Ours	C	EffNet-B4	**30**	47.2	33.8	**44.0**	**41.7**	**18.2**

[1]Li et al. HDMapNet: An Online HD Map Construction and Evaluation Framework. ICRA 2022

[2]Liu et al. VectorMapNet: End-to-end Vectorized HD Map Learning. ICLR 2023

Conclusion & Future Work

- Conclusion
  - InstaGraM stably predicts the structure of the map elements
  - Proposed instance-level graph modeling and network outperforms comparison models by up to 13.7 mAP, with up to 33× faster computation
- Future work
  - Extend to temporal aggregation with vehicle poses for a complete mapping of environment (automatic HD map generation)