



Tencent



OpenSatMap: A Fine-grained High-resolution Satellite Dataset for Large-scale Map Construction

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Paper:



Dataset:



Project:



❖ Background

Road map construction

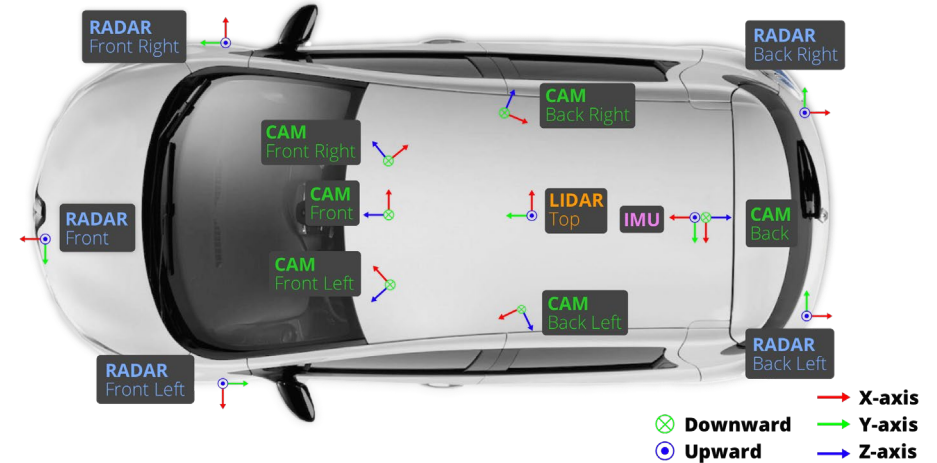


Road map construction is fundamental to many tasks such as navigation and autonomous driving.

❖ Background

❑ Existing Benchmarks

- Ego View Map Construction
 - Use **cameras and radar** to construct maps. (HDMaNet, MapTR, ...)
 - Accurate but expensive.
- Satellite Map Construction
 - Use **satellite images** to build maps. (RoadTracer, SPIN, ...)
 - Cheap but inaccurate.



❖ Background

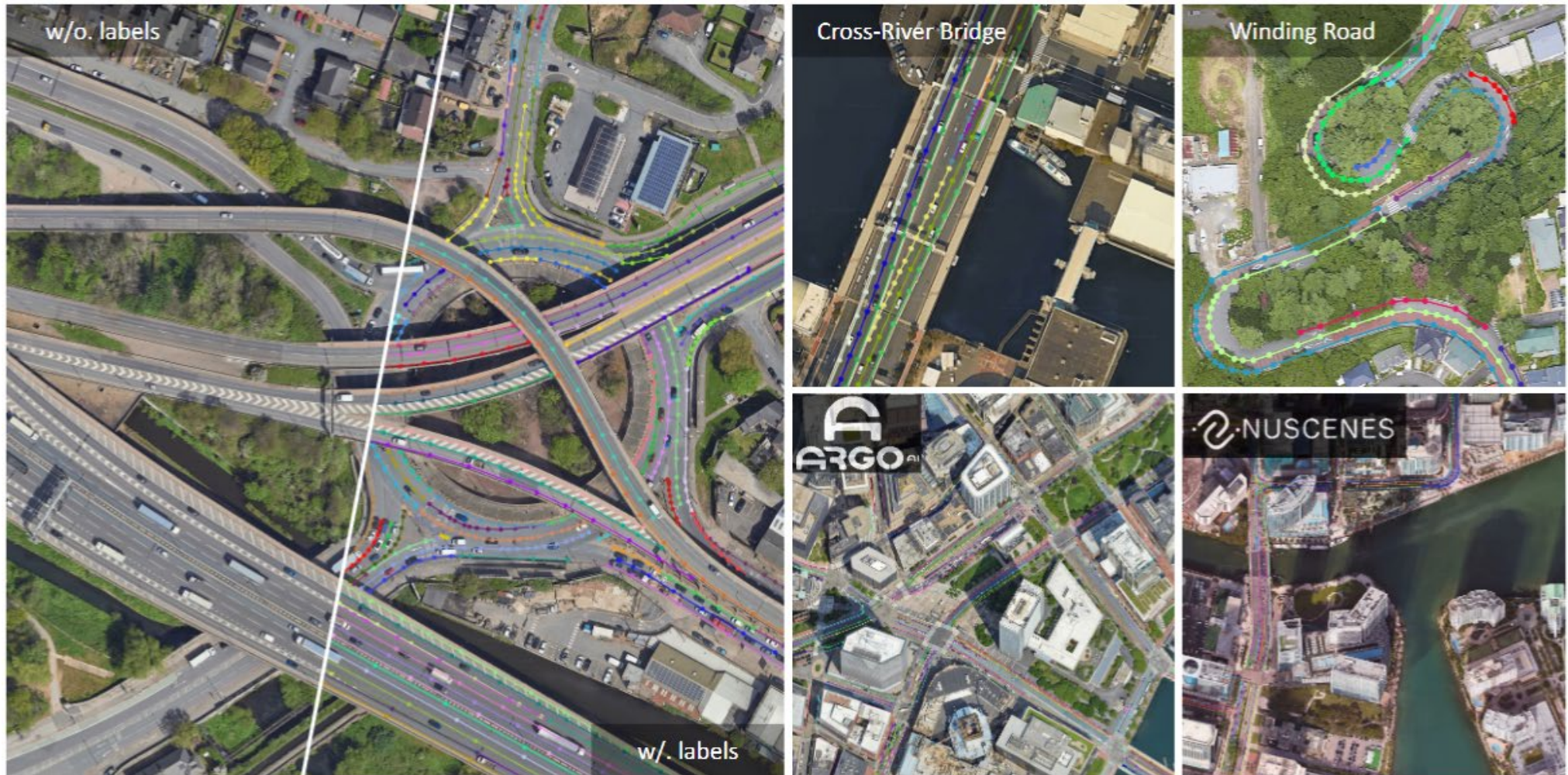
❑ Satellite Map Construction

- Coarse annotations: Semantic-level
- Low resolution: Inadequate for accurate perception of lane lines
- Small Scale: Less than 10k 1024 * 1024 images
- Unalignment with AD benchmarks

Dataset	# of Images*	Resolution	GT Source	Labeling Level	Region
Massachusetts [35]	2513	1.00 <i>m/pixel</i>	OSM	Semantic	America
CasNet [13]	77	1.20 <i>m/pixel</i>	Manually	Semantic	-
DeepGlobe [16]	8570	0.50 <i>m/pixel</i>	QGIS	Semantic	3 Counties
SpaceNet [43]	4481	0.31 <i>m/pixel</i>	OSM	Semantic	4 Counties
Roadtracer [6]	4800	0.60 <i>m/pixel</i>	OSM	Semantic	6 Counties
Ottawa [33]	235	0.30 <i>m/pixel</i>	Manually	Semantic	Canada
CHN6-CUG [48]	4511	0.50 <i>m/pixel</i>	Manually	Semantic	China
OpenSatMap (Ours)	7224 31696	0.30 <i>m/pixel</i> 0.15 <i>m/pixel</i>	Manually	Instance, Vectorized	60 Cities, 19 Countries

❖ OpenSatMap

❑ OpenSatMap: A Fine-grained High-resolution Satellite Dataset



❖ OpenSatMap

□ OpenSatMap: Data Collection



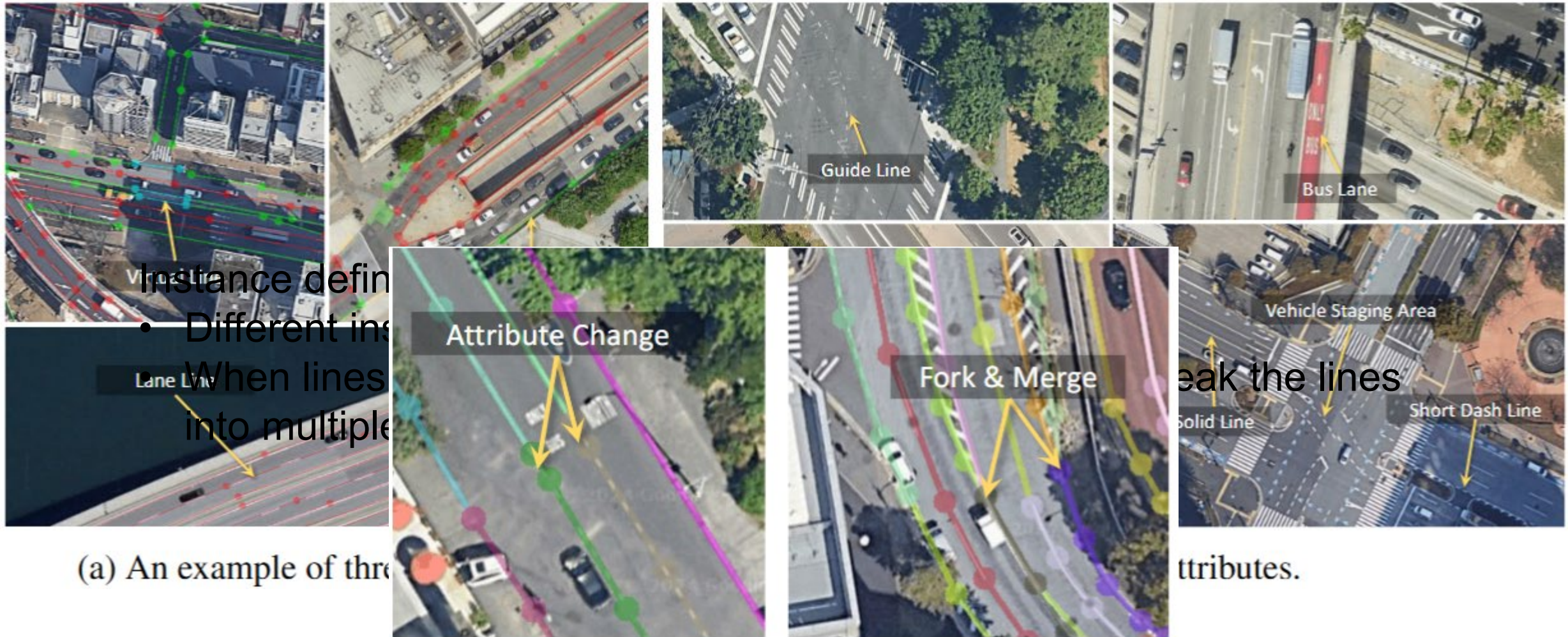
(a) Landmark correspondences between a satellite image and a nuScenes image.



(b) Overlaying the driving trajectories from the nuScenes dataset onto OpenSatMap (Boston Seaport).

❖ OpenSatMap

□ OpenSatMap: Annotation



(a) An example of three

(a) Attribute change.

(b) Lines fork and merge.

attributes.

❖ OpenSatMap

□ OpenSatMap: Annotation

Image-level tag



(a) Flyover.



(b) Cross-river bridge.



(c) Roundabout



(d) Winding road.

Figure 4: Special road structure examples.

(a) Urban.

(b) Suburban.

(c) Rural.

Figure 3: Settlement type examples.

❖ OpenSatMap: Statistics

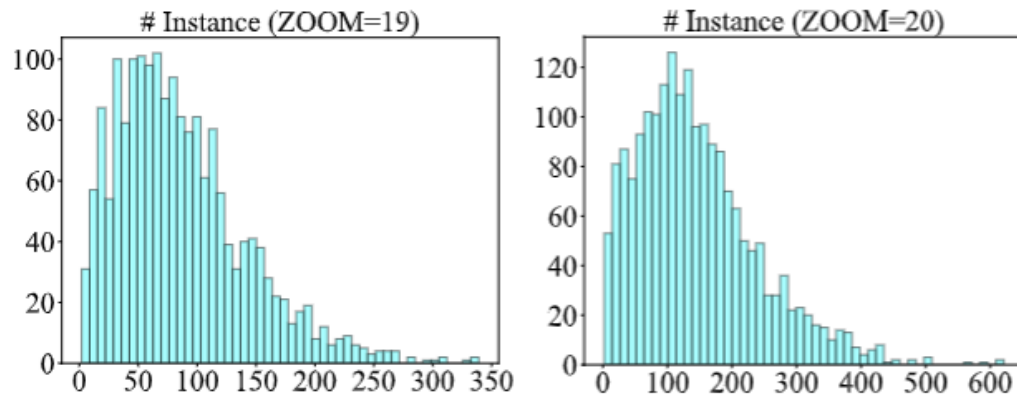


Figure 5: Number of instances in each image in OpenSatMap19 (left) and OpenSatMap20 (right).

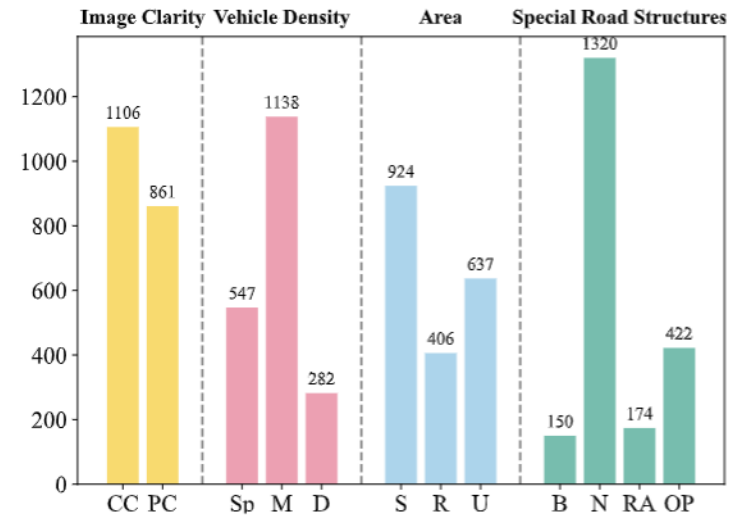
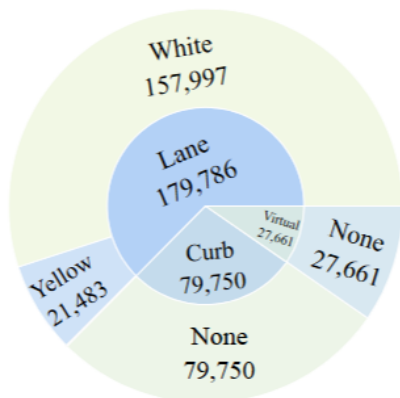
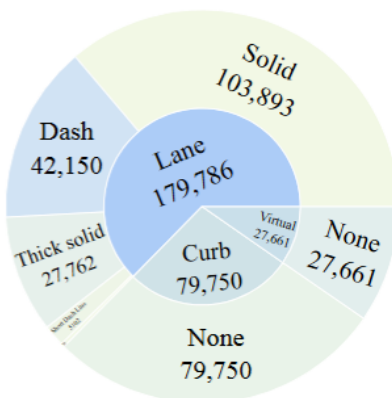


Figure 7: **Image-level tag distribution in OpenSatMap20.** CC = complete clear, PC = partially clear, Sp = sparse, M = moderate, D = dense, S = suburban, R = rural, U = urban, B = bridge, N = None, RA = roundabout, OP = overpass.

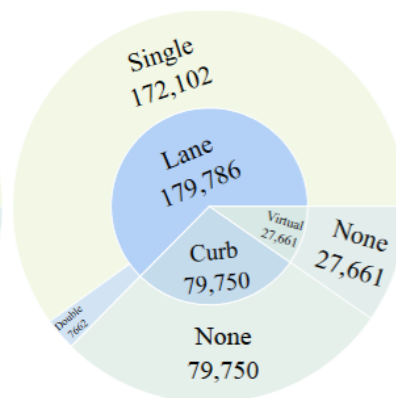
❖ OpenSatMap: Statistics



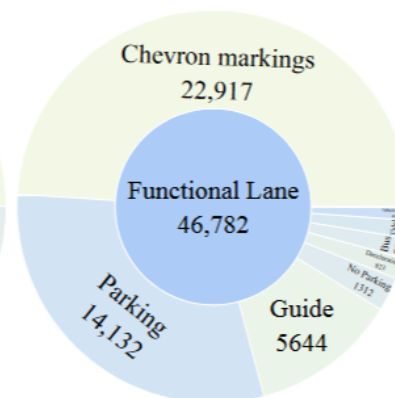
(a) Color distribution.



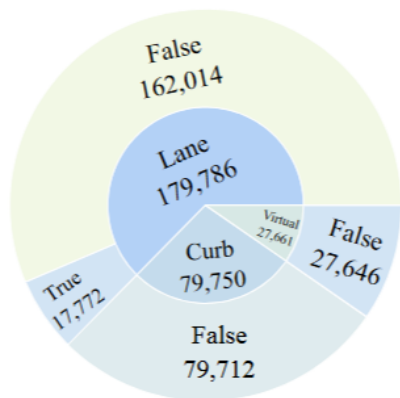
(b) Line type distribution.



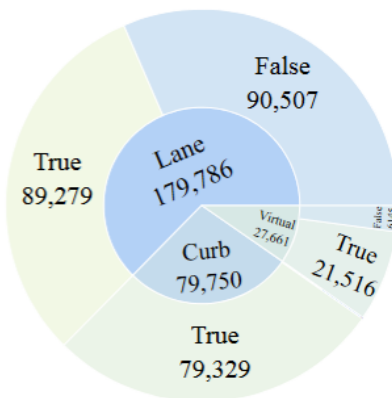
(c) # lines distribution.



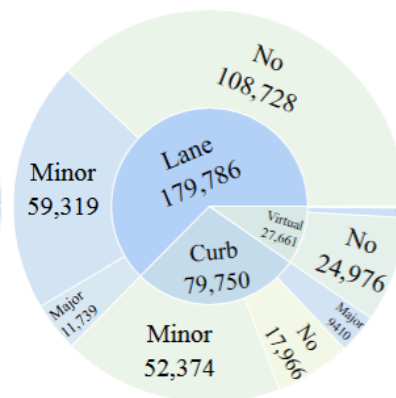
(d) Function distribution.



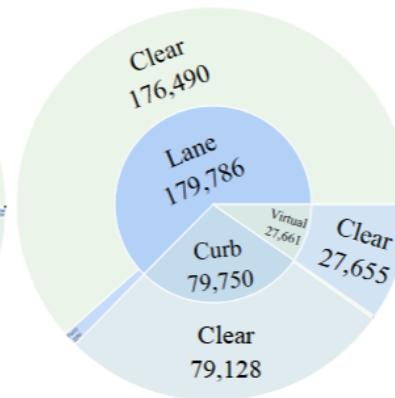
(e) Bidirection distribution.



(f) Boundary distribution.



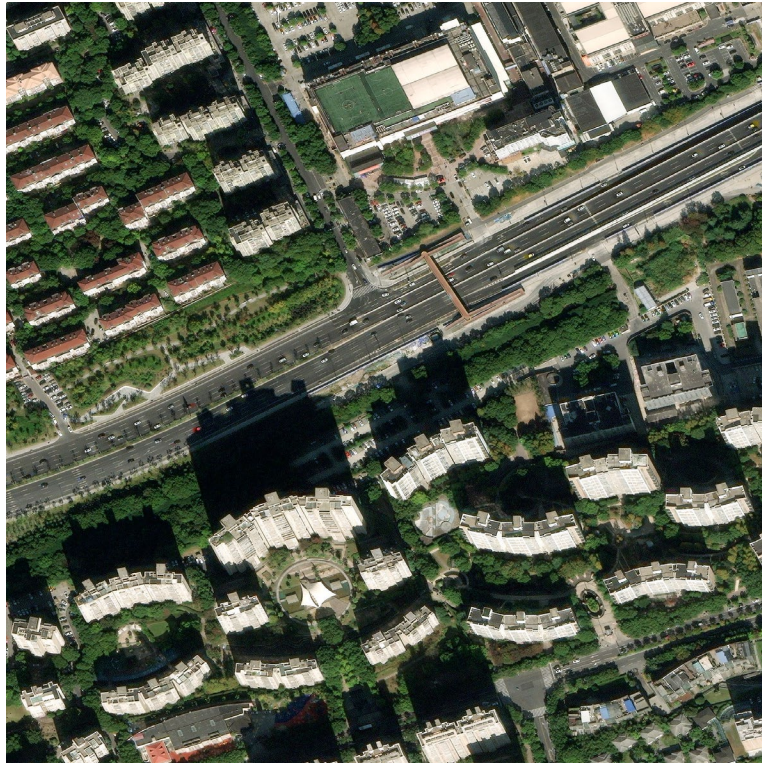
(g) Occlusion distribution.



(h) Clearness distribution.

❖ Benchmark: Instance-level Line Detection

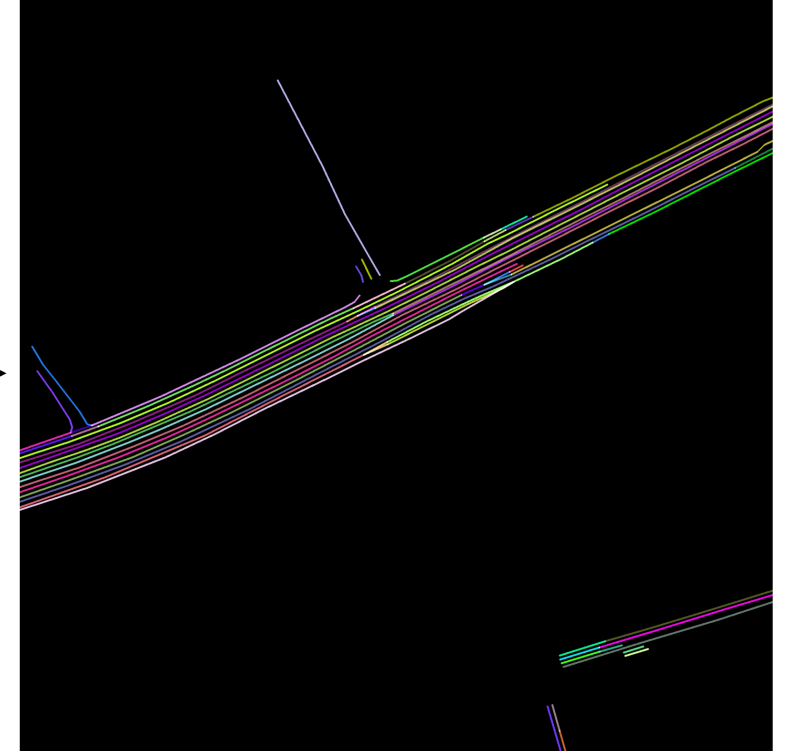
Task Formulation



Input: satellite images

Curve
Prediction

Output: Instance-level lines



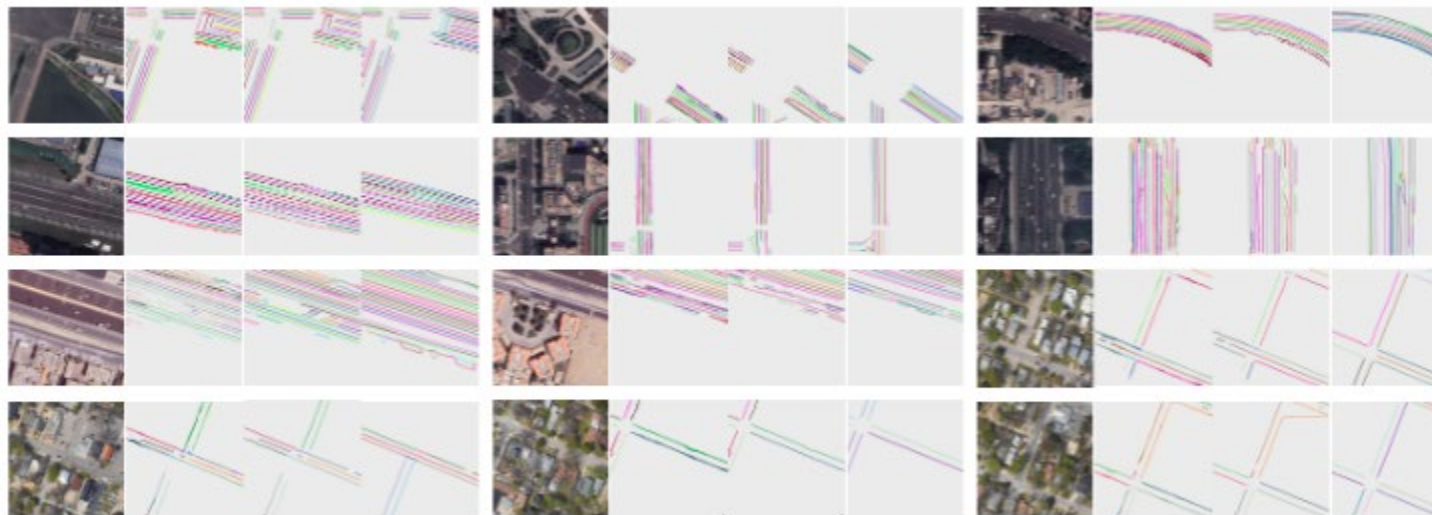
❖ Benchmark: Instance-level Line Detection

□ Evaluation Metrics

- Mask AP: The same as instance segmentation.
- Chamfer AP:

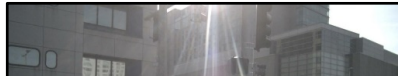
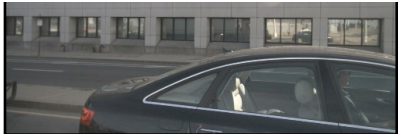
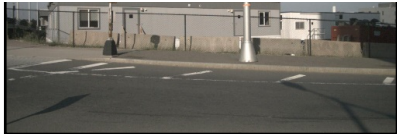
- Chamfer distance: $D_{\text{Chamfer}}(\mathbf{p}, \mathbf{q}) = \frac{1}{M} \sum_{i=1}^M \min_{j=1,2,\dots,K} d(p_i, q_j),$

Dataset	$\text{AP}_{0.9}^C$	$\text{AP}_{1.5}^C$	$\text{AP}_{3.0}^C$	$\text{AP}_{4.5}^C$	$\text{AP}_{50:95}^M$	AP_{50}^M	AP_{75}^M	mIoU
OpenSatMap19	16.04 ± 0.35	22.68 ± 0.35	26.88 ± 0.52	29.18 ± 0.22	3.66 ± 0.15	10.66 ± 0.44	1.45 ± 0.12	28.71 ± 0.38
OpenSatMap20	20.30 ± 0.21	25.93 ± 0.35	29.50 ± 0.40	31.38 ± 0.43	6.98 ± 0.21	16.05 ± 0.32	5.26 ± 0.13	33.69 ± 0.45



❖ Benchmark: Satellite-enhanced Online Map Construction

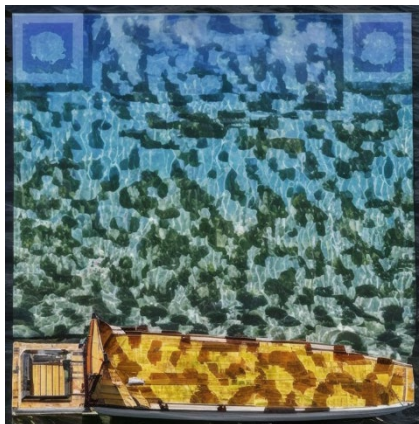
We leverage satellite images as an **additional input modality** to enhance online map construction methods.

				
Method	Divider	Crossing	Boundary	All
HDMaNet [34]	40.6	18.7	39.5	32.9
SatforHDMaNet [23]	50.2	53.2	49.4	50.9
				
				

Paper:



Dataset:



Project:

