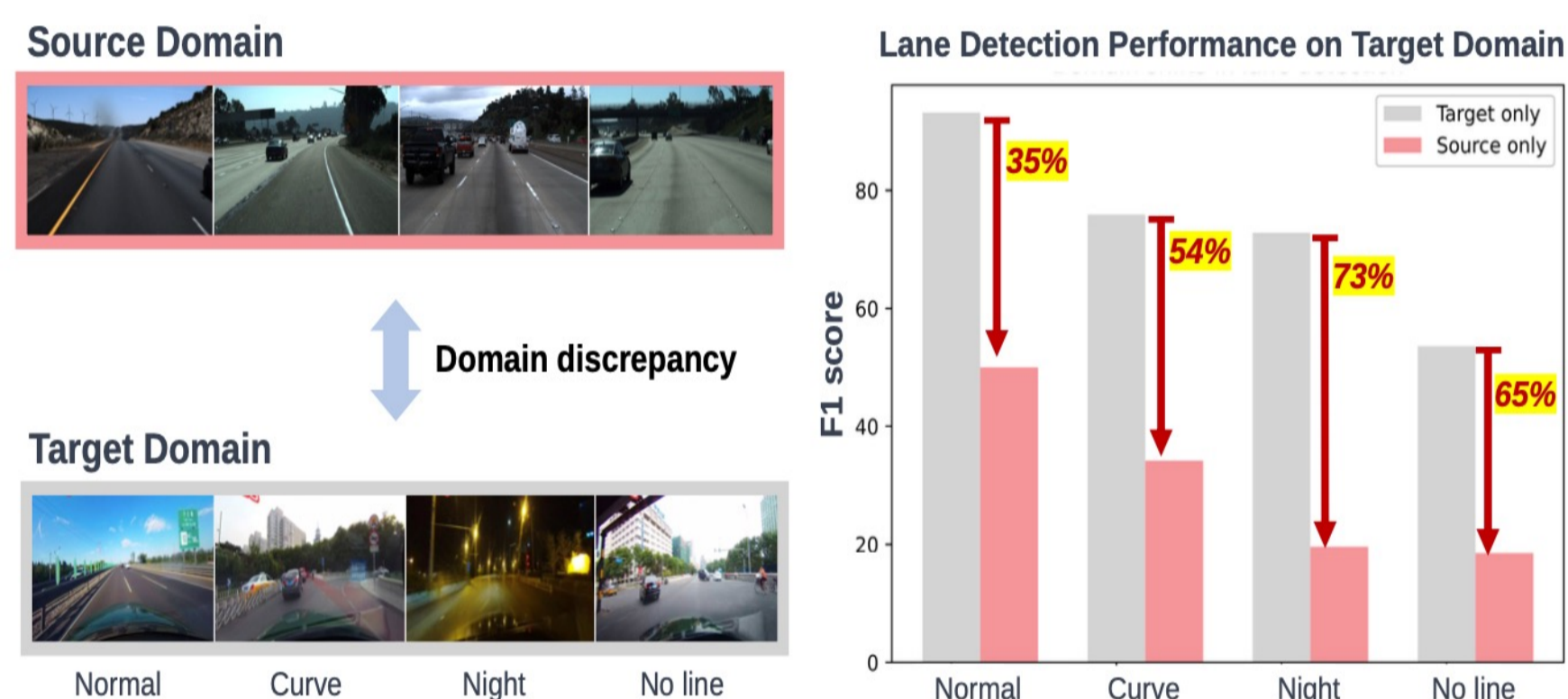# HD Maps are Lane Detection Generalizers:
A Novel Generative Framework for Single-Source Domain Generalization

Daeun Lee, Minhyeok Heo, Jiwon Kim

Korea University, NAVER LABS

KOREA UNIVERSITY — NAVER LABS

Motivation

❑ The overall framework using HD Maps

Source Domain — Target Domain — Domain discrepancy — Normal, Curve, Night, No line

Lane Detection Performance on Target Domain — F1 score — Target only / Source only — 35% / 54% / 73% / 65%

Current data-driven lane detection models still suffer from **performance degradation** when tested on unseen domains.

❑ Domain Discrepancy in Lane Detection
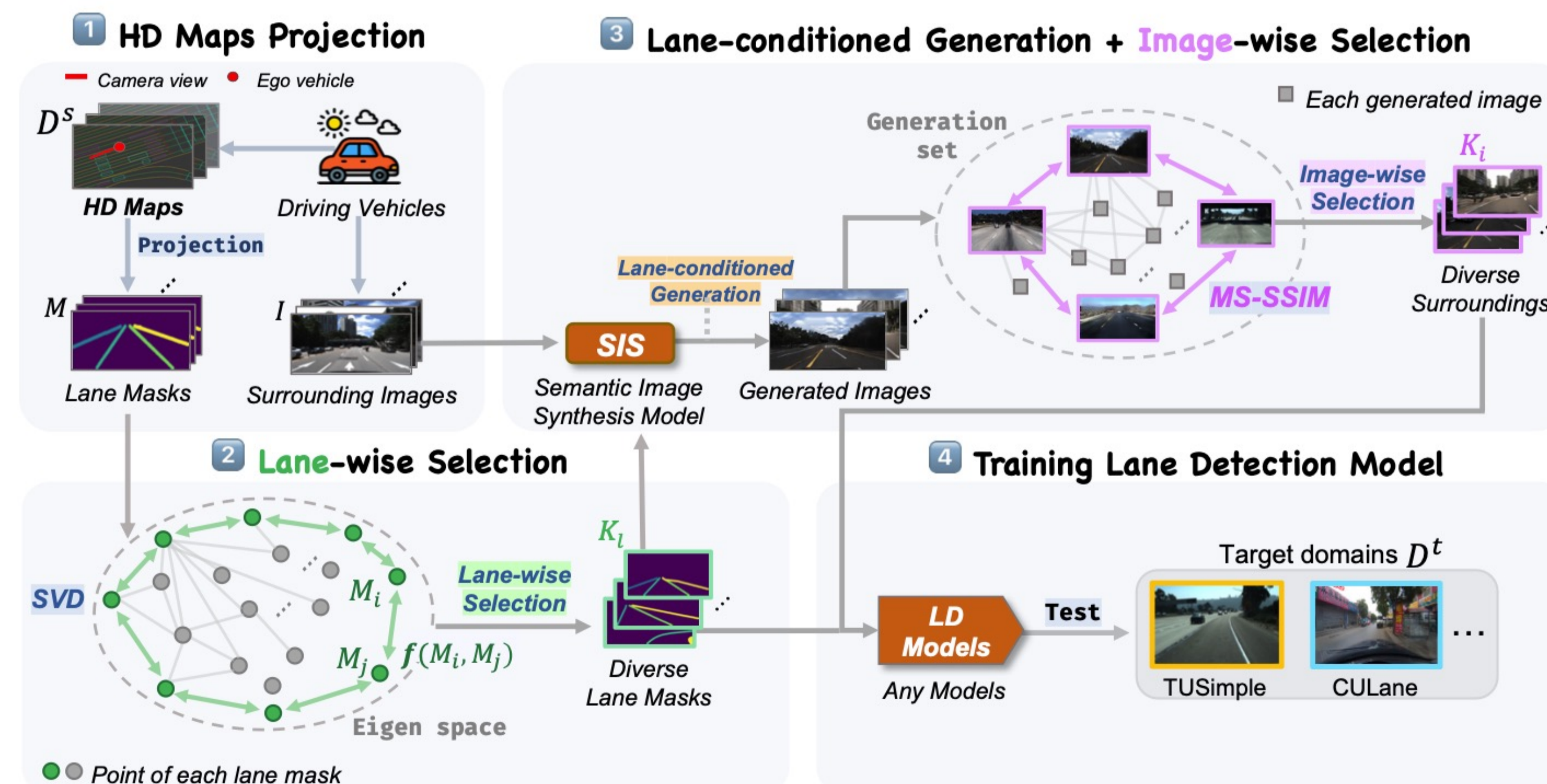

The number of lanes — The curvature of lanes — Feature space from ResNet-18
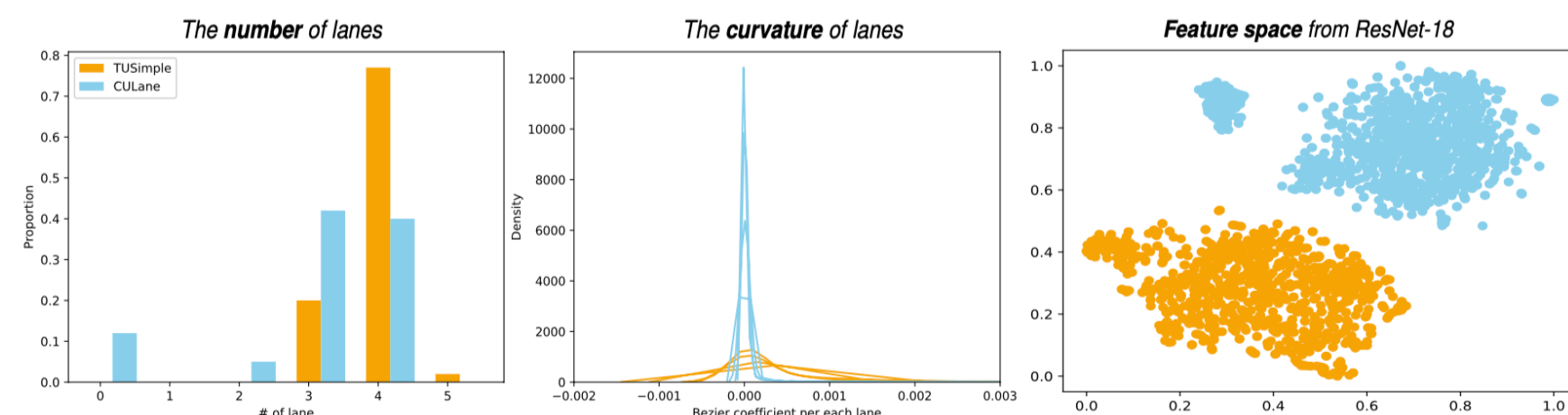
We categorized the cause of domain discrepancy in lane detection to *(i) Lane structures* and *(ii) Surrounding images.*

Methodology

❑ The overall framework using HD Maps

1. **HD Maps Projection** — Camera view, Ego vehicle — D^s — HD Maps — Driving Vehicles — Projection — M — Lane Masks — I — Surrounding Images

2. **Lane-wise Selection** — SVD — M_i — M_j — $f(M_i, M_j)$ — K_l — Diverse Lane Masks — Eigen space — ● Point of each lane mask

3. **Lane-conditioned Generation + Image-wise Selection** — Lane-conditioned Generation — SIS — Semantic Image Synthesis Model — Generated Images — Generation set — *Each generated image* — Image-wise Selection — MS-SSIM — K_i — Diverse Surroundings

4. **Training Lane Detection Model** — LD Models — Test — Target domains D^t — TUSimple — CULane — Any Models

We first **extract** numerous lane masks from **HD Maps** with surrounding images. Then, we train SIS (Semantic Image Synthesis) models to synthesize **lane-conditioned images** with *diverse* surroundings. We select a core set among synthesized images with two criteria to maximize its diversity: *(i) lane structure* and *(ii) surroundings*. Then, we finally train the lane detection model and obtain enhanced **generalization** performance.

Experiments

❑ Quantitative Results on CULane

Experiment setting	Trained data			Total	Normal	Crowded	Night
	TUSimple	CULane	LabsLane				
Source only - ERFNet	✔			24.2	41	19.6	9.1
Source only - GANet	✔			30.5	50	25.5	19.6
Advent [24]	✔	✔		30.4	49.3	24.7	20.5
PyCDA [13]	✔	✔		25.1	41.8	19.9	13.6
Maximum Squares [1]	✔	✔		31	50.5	27.2	20.8
MLDA [9]†	✔	✔		38.4	**61.4**	**36.3**	27.4
Source only - GANet			✔	34.9	52.4	25.9	27.1
Ours - ERFNet			✔	38.2	56.8	32.5	24.4
Ours - GANet			✔	**39.6**	56.7	34	**30.1**

❑ Qualitative Results from Generative Model

(a) Lane label mask — (b) Selected 5 synthesized RGB images
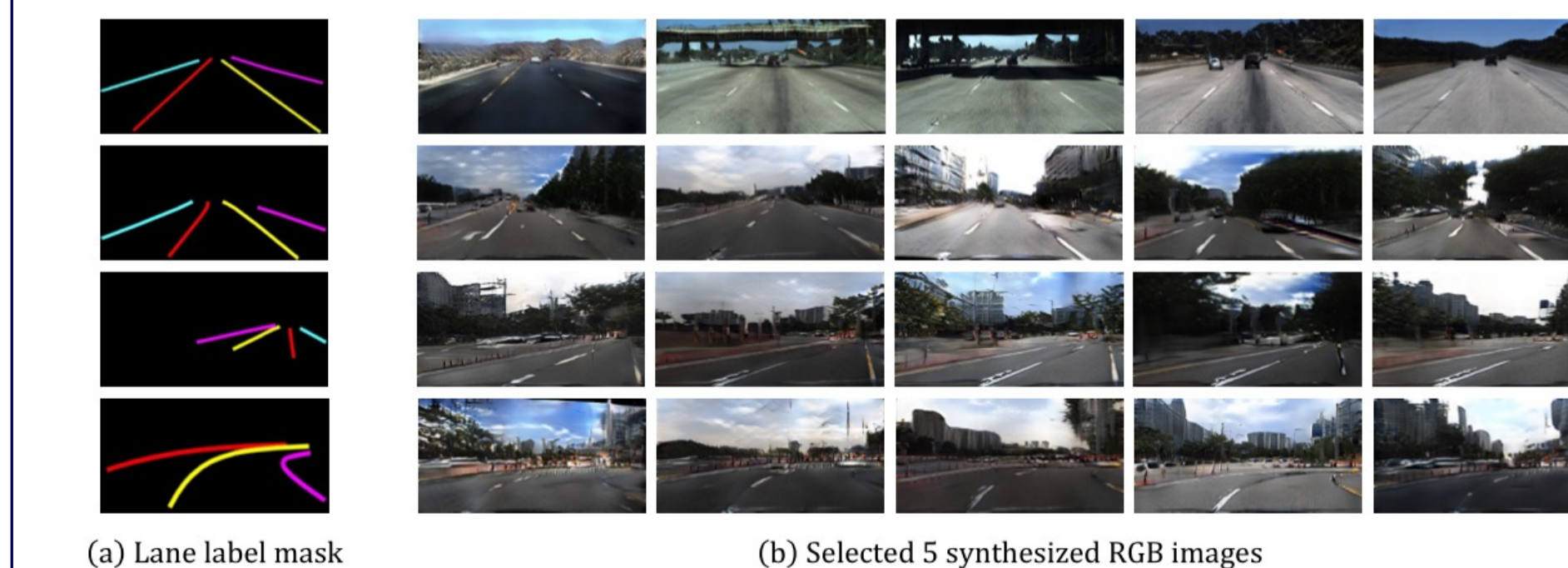
Conclusion

We propose a novel training framework that utilizes HD Maps for robust lane detection