

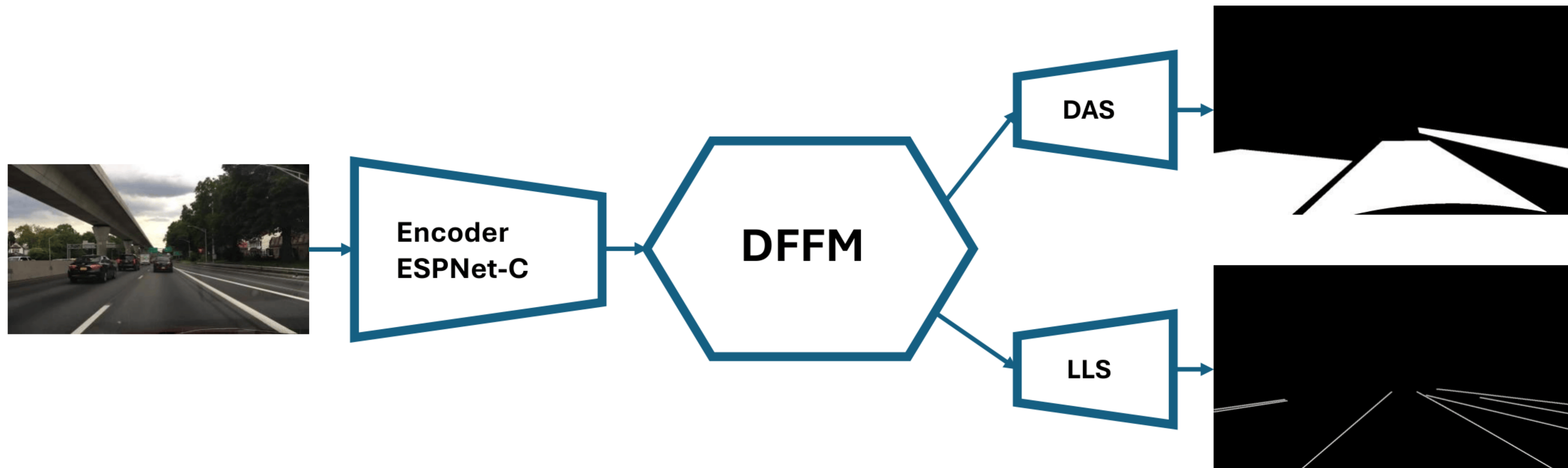
Motivation

- Autonomous driving requires efficient visual perception in real time.
- Drivable Area Segmentation (DAS) and Lane Line Segmentation (LLS) are key tasks for road scene understanding.
- However, many segmentation models are computationally expensive, limiting deployment on embedded devices.
- We propose a lightweight dual-task model that jointly performs DAS and LLS by exploiting global shared features, while preserving low-level task-specific details.

Proposed Method

Main components:

- Lightweight shared encoder:** ESPNet-C
- Dual-task Feature Fusion Module (DFFM)**
- Task-specific heads:** two decoder heads produce the final DAS and LLS segmentation maps.

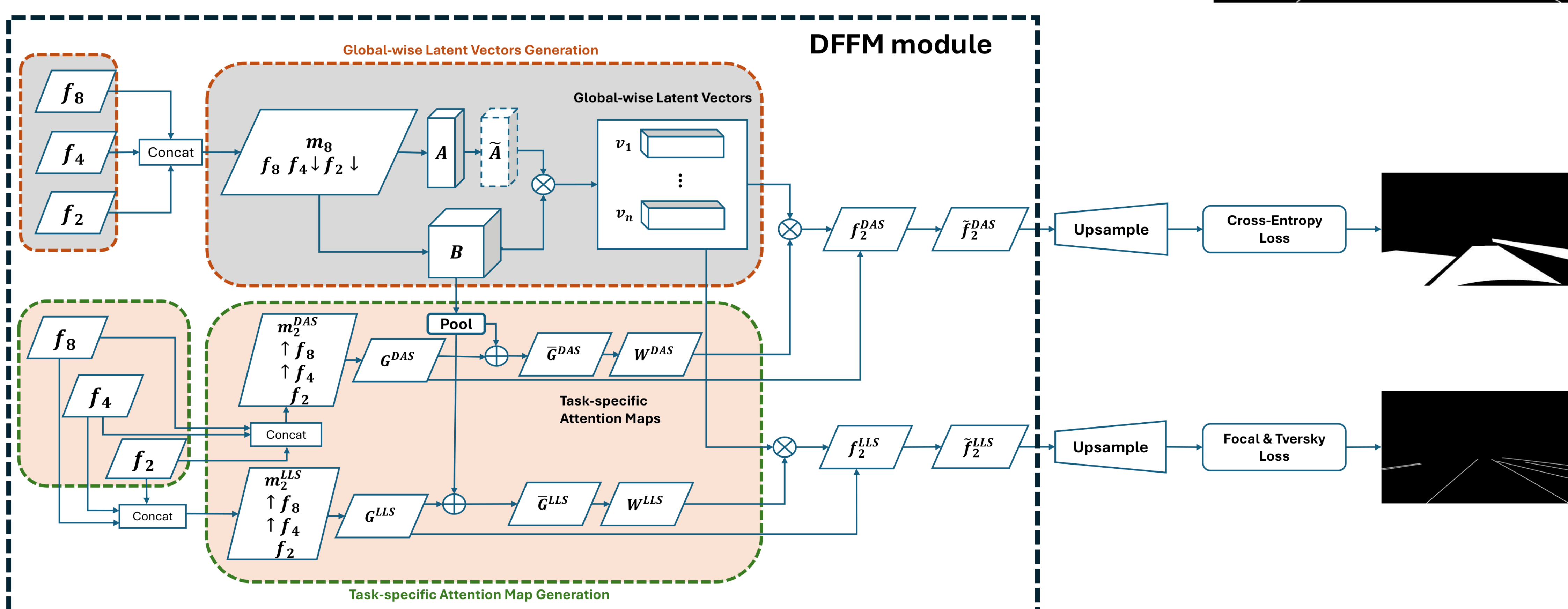


Novel DFFM Design

- Fuses multi-scale feature maps f_2 , f_4 , and f_8 .
- Generates global-wise latent vectors to capture high-level contextual information.
- Produces task-specific attention maps for DAS and LLS.
- Combines global context with low-level task-specific details to reduce task interference.

DFFM Core Principle

DFFM enhances shared feature representations while preserving task-specific information for two visually different tasks: large drivable road regions and thin lane-line structures, reducing negative transfer.

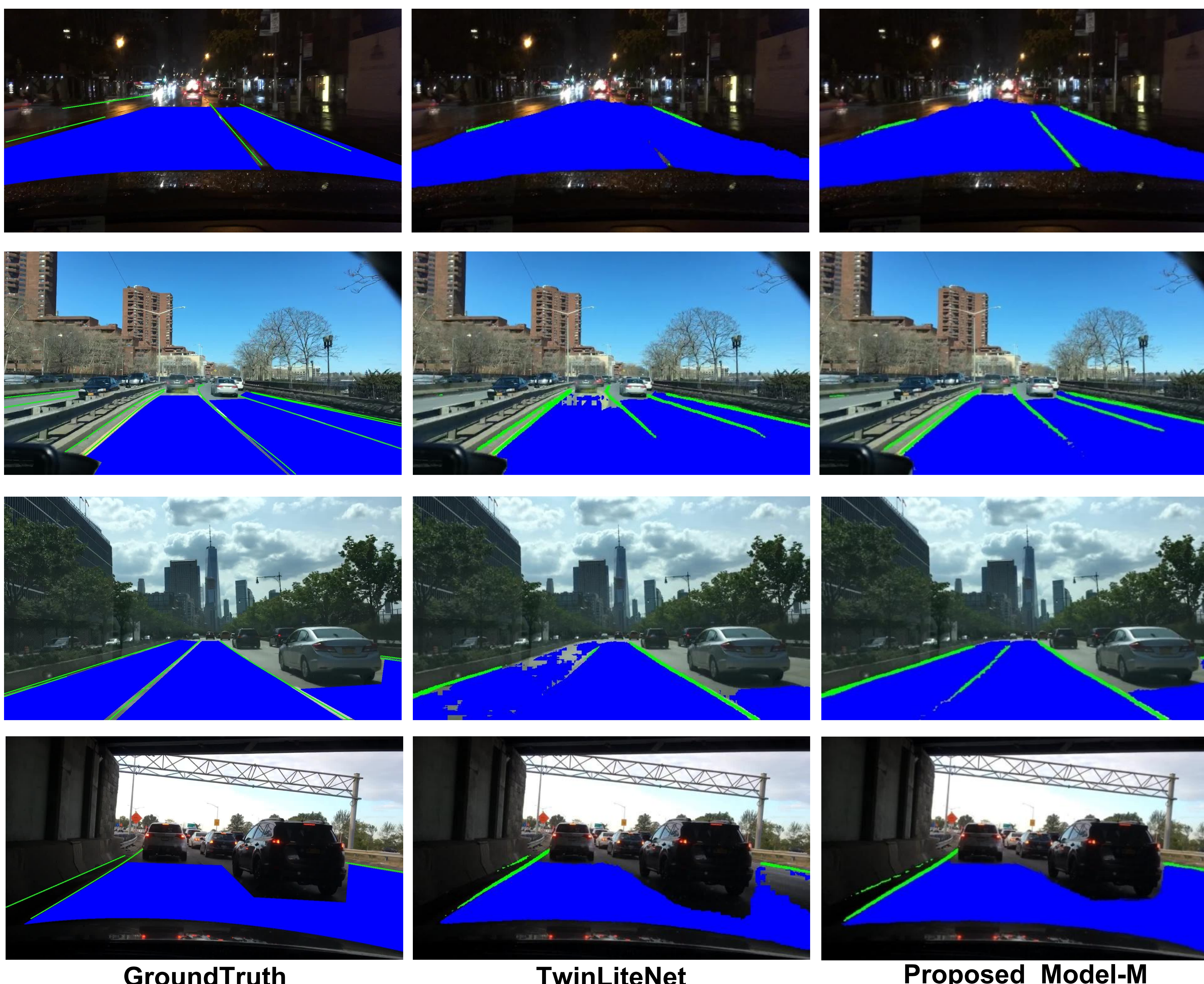


Experiments

Dataset: **BDD100K**

- 100,000 annotated driving images
- 70k train / 10k validation / 20k test images.
- Tasks: Drivable Area Segmentation and Lane Line Segmentation.
- The proposed model achieves competitive DAS performance and the best LLS Accuracy/IoU among the compared methods, using only 0.5M parameters.

Network	DAS mIoU	LLS Acc	LLS IoU	Params (M)
HybridNets	90.5	85.4	31.60	12.8
YOLOP	91.5	70.50	26.20	7.9
YOLOPv2	93.2	87.31	27.25	38.9
YOLOPX	93.2	88.6	27.2	32.9
TwinLiteNet	91.3	<u>97.3</u>	31.08	0.44
YOLOMH	<u>92.7</u>	87.72	29.40	11.91
A-YOLOM(n)	90.5	81.30	28.20	4.43
A-YOLOM(s)	91.0	84.90	28.80	13.61
Proposed_model-M	92.0	98.97	31.63	<u>0.5</u>



Proposed Variation	DAS mIoU (%)	LLS Acc (%)	LLS IoU (%)	FPS	Params	FLOPS	Size
Nano	88.72	98.89	25.30	69	0.03M	0.72G	0.22 MB
Small	90.82	98.95	29.30	66	0.13M	2.65G	0.64 MB
Medium	92.00	98.97	31.63	60	0.5M	10.17G	2.3 MB
Large	92.12	98.96	32.12	49	2.2M	39.79G	8.9 MB

Conclusion

By combining global context with task-specific attention through DFFM, the proposed dual-task lightweight model achieves an effective accuracy–efficiency trade-off for real-time DAS and LLS on BDD100K, while using only 0.5M parameters.

