

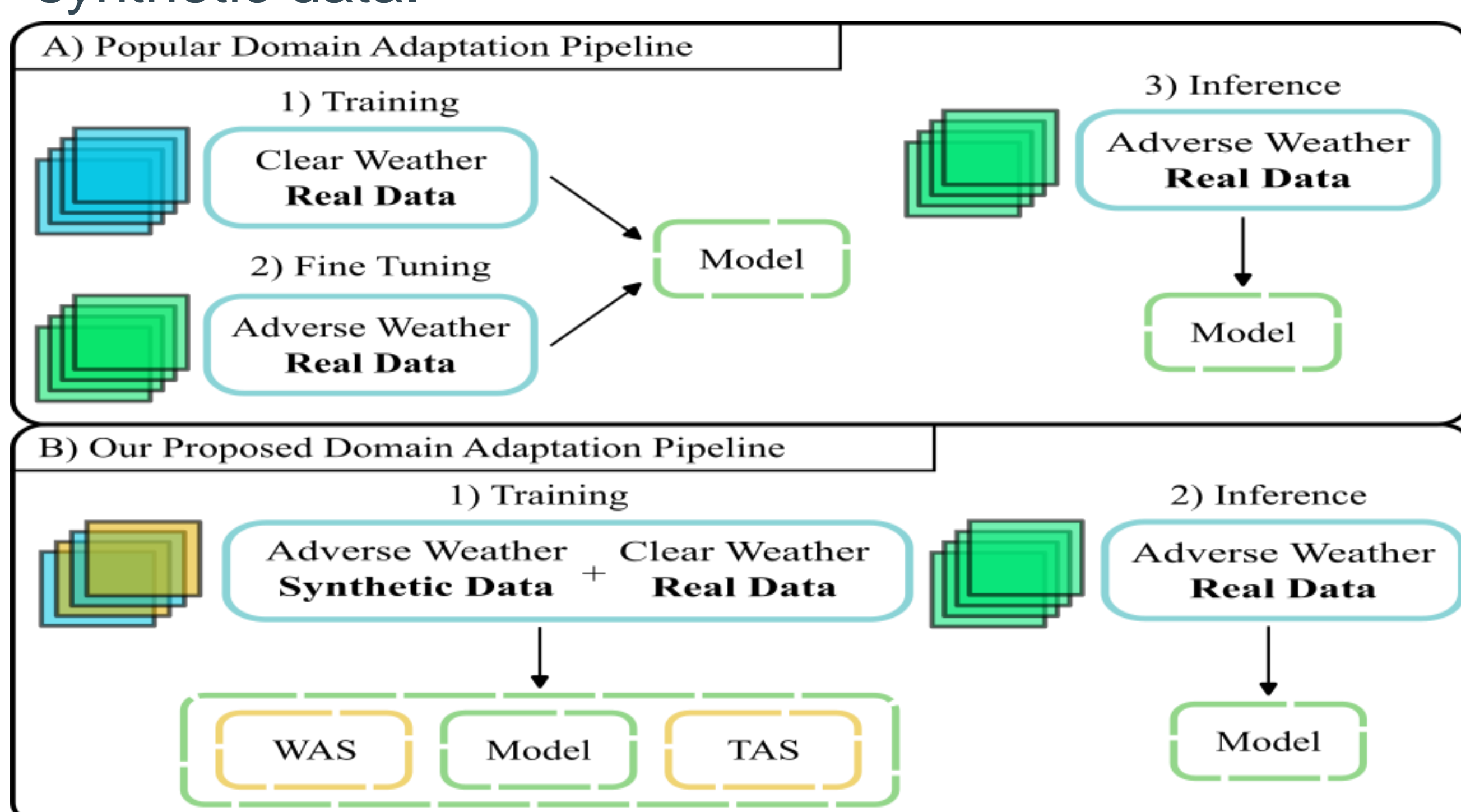
Semantic Segmentation under Adverse Conditions: A Weather and Nighttime-aware Synthetic Data-based Approach

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Motivation & Summary



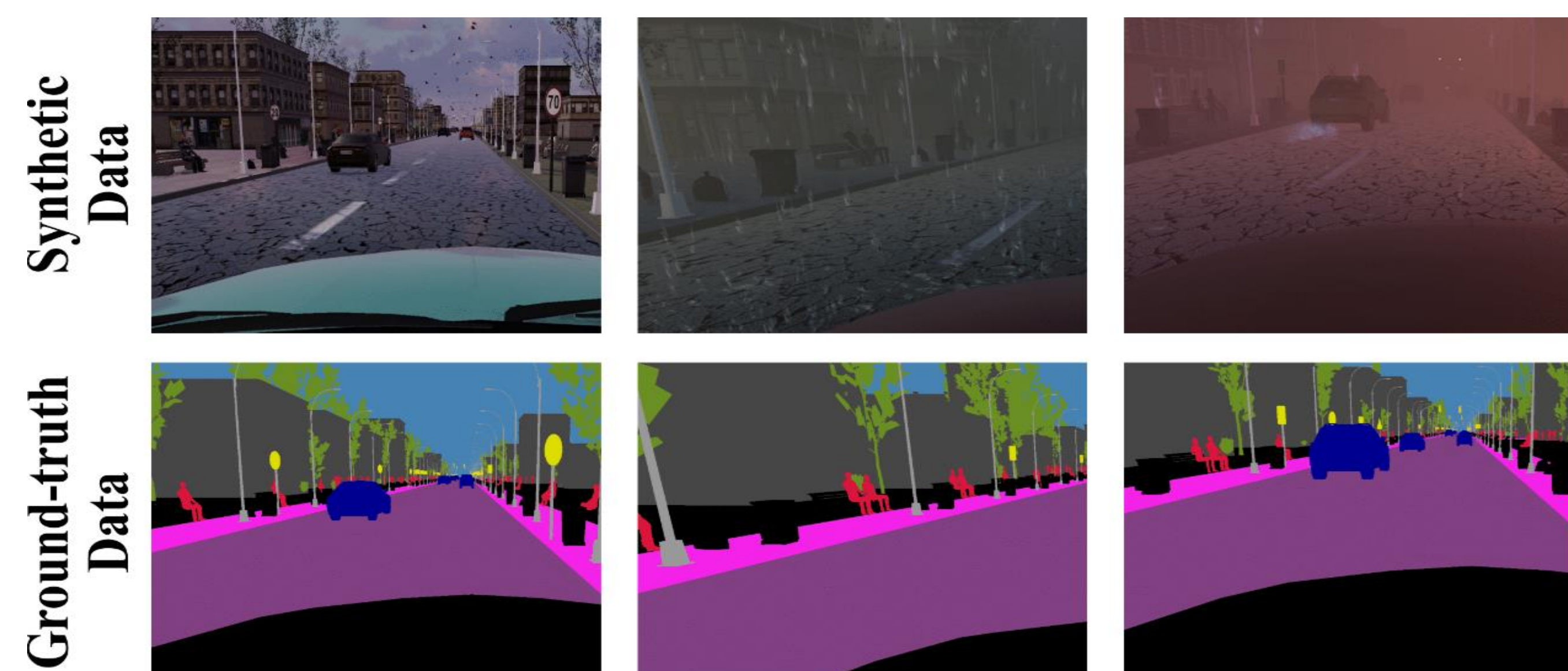
- SOTAs are good under standard conditions but **struggle under adverse conditions**.
- Using more real/synthetic data alone is **not ideal**.
- We propose a novel **synthetic-aware** training procedure with a **special architecture** to learn robust features under adverse conditions leveraging synthetic data.



AWSS Overview

- Issues with current datasets!
- We extend *Silver* [1], a simulator to generate synthetic data.
- AWSS dataset: 1,250 images, 1,200×780 pixels, normal, rainy, foggy, and snowy weather conditions, daytime and nighttime.

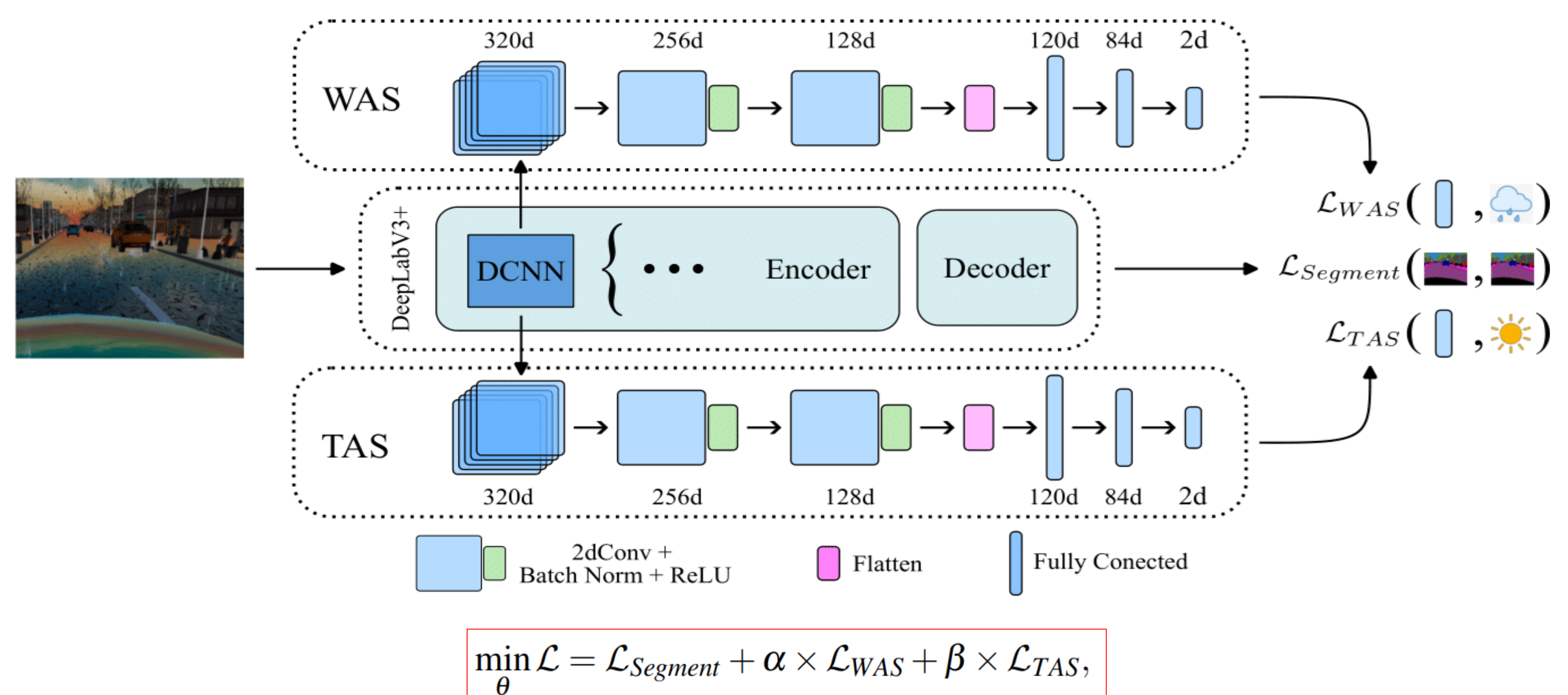
	Weather Conditions				Times-of-Day		Photo-realism	Public Availability
	Normal	Rain	Fog	Snow	Daytime	Nighttime	/	/
GTA-V	✓	✓	-	-	✓	-	✓	✓
Synscapes	✓	-	-	-	✓	-	✓	✓
Virtual KITTI	✓	✓	✓	-	✓	-	-	✓
Synthia	✓	✓	-	✓	✓	✓	-	-
SHIFT	✓	✓	✓	-	✓	✓	✓	✓
AWSS (Ours)	✓	✓	✓	✓	✓	✓	✓	✓



References

- [1] Abdulrahman Kerim, Leandro Soriano Marcolino, and Richard Jiang. Silver: Novel rendering engine for data hungry computer vision models. In 2nd Intern. Workshop on Data Quality Assessment for Machine Learning, 2021.
- [2] Marius Cordts, Mohamed Omran, Sebastian Ramos, Timo Rehfeld, Markus Enzweiler, Rodrigo Benenson, Uwe Franke, Stefan Roth, and Bernt Schiele. The cityscapes dataset for semantic urban scene understanding. In Proceedings of CVPR, pages 3213–3223, 2016.
- [3] Christos Sakaridis, Dengxin Dai, and Luc Van Gool. ACDC: The adverse conditions dataset with correspondences for semantic driving scene understanding. In Proceedings of ICCV, pages 10765–10775, 2021.

Semantic Segmentation Model



- Reduce domain shift **with no additional real data**.
- Learn weather and daytime-nighttime specific and **robust** features.
- Synthetic-aware training procedure.
- Utilize WAS and TAS with multi-task learning.

Experimental Evaluation

- Training: AWSS and the training split of Cityscapes [2].
- Evaluation: validation splits of Cityscapes and ACDC [3].
- Evaluation metric: Mean Intersection over Union (mIoU).
- Recent methods **degrade** under adverse conditions.
- Transfer Learning degrades the performance on the source domain.
- Our solution is **the best** on the target domain (adequate on source domain).

		ACDC					Cityscapes
		Rain	Fog	Snow	Night	Overall	Overall
DeepLabV3+	Baseline	0.41	0.46	0.36	0.17	0.35	0.78
	FnT on AWSS	0.44	0.48	0.47	0.19	0.39	0.59
HRNet	Baseline	0.46	0.42	0.41	0.09	0.35	0.75
	FnT on AWSS	0.47	0.49	0.35	0.14	0.36	0.51
DANet	Baseline	0.47	0.57	0.44	0.21	0.42	0.82
	FnT on AWSS	0.48	0.58	0.48	0.26	0.45	0.74
PSPNet	Baseline	0.49	0.54	0.43	0.20	0.41	0.86
	FnT on AWSS	0.52	0.56	0.46	0.18	0.43	0.86
Ours	Full-Model	0.57	0.60	0.50	0.27	0.49	0.75

