Adapt, But Don't Forget: Fine-Tuning and Contrastive Routing for Lane Detection under Distribution Shift

Supplementary Material

8. Rationale for Fine-Tuning Configurations

Here, we provide the motivations for each configuration $\theta'_c \subseteq \theta$, outlining the intuition behind the choice of trainable components and their impact under distribution shift.

- **Bias:** $\theta'_c = \{\text{bias}(\theta_i)\}$, where $i \in \{H\}$ or $\{N, H\}$. Updating only the bias terms allows localized adaptation with minimal parameter updates, offering a lightweight alternative to mitigate distribution shift while largely preserving source representations.
- **Head:** $\theta'_c = \{\theta_H\}$. Fine-tuning the detection head refines anchor-specific predictions and confidence calibration to better align with the LaneIoU metric.
- **Neck + Head:** $\theta'_c = \{\theta_N, \theta_H\}$. Adding the neck enables adaptation of feature aggregation across scales, allowing the model to better represent lane geometries that vary in curvature, spacing, or resolution in the target distribution.
- **Partial Backbone:** $\theta'_c = \{\theta_B^{(k)}, \theta_N, \theta_H\}$, where $\theta_B^{(k)}$ denotes the final k layers of the backbone. This configuration enables adaptation of higher-level features sensitive to lane geometry, curvature, and anchor offsets, while preserving early low-level features to minimize forgetting.
- **Full Fine-Tuning:** $\theta'_c = \{\theta_B, \theta_N, \theta_H\}$. This setting provides full adaptation capacity but risks erasing generalizable or source-specific knowledge, especially in lower-level feature extractors.

9. Additional Results

We present detailed precision, recall, and F1-score breakdowns for all fine-tuning configurations in Tables 4 and 5, corresponding to CurveLanes and AssistTaxi target distributions, respectively. Each table reports both source (CULane) and target performance after selectively fine-tuning model components. In addition to F1-score, which is analyzed in the main paper, these tables reveal trends in precision and recall that offer deeper insight into the nature of distribution adaptation and forgetting. For every metric, we include the relative *drop* from the no-finetuning CULane baseline and the *gain* over the zero-shot baseline on the target distribution, highlighting trade-offs between forgetting and adaptation across configurations.

Table 4. The base model is trained on CULane, and results are shown after fine-tuning different components on CurveLanes. Precision, Recall, and F1-score are reported at a confidence threshold of 0.5. For each setting, we show source (CULane) and target (CurveLanes) performance, with relative *drops* from the CULane no-finetuning baseline and *gains* over the CurveLanes zero-shot baseline indicated in parentheses.

Backbone	**FT Config**	**CULane (Src)**			**CurveLanes (Tgt)**			**#Params**
		F1 (drop)	Prec (drop)	Rec (drop)	F1 (gain)	Prec (gain)	Rec (gain)	
DLA-34	No fine-tuning	81.2	89.3	74.4	65.0	94.4	49.5	0
	bias(H)	78.4 (-2.8)	81.4 (-7.9)	75.6 (+1.2)	71.6 (+6.6)	89.4 (-5.0)	59.7 (+10.2)	1,330
	bias(N+H)	78.8 (-2.4)	82.9 (-6.4)	75.2 (+0.8)	71.6 (+6.6)	89.1 (-5.3)	59.9 (+10.4)	1,714
	H	73.3 (-7.9)	73.0 (-16.3)	73.6 (-0.8)	77.1 (+12.1)	90.8 (-3.6)	67.1 (+17.6)	432,450
	N+H	70.8 (-10.4)	69.3 (-20.0)	72.3 (-2.1)	78.6 (+13.6)	91.7 (-2.7)	68.8 (+19.3)	600,770
	$B^{(k=2)}$+N+H	70.2 (-11.0)	69.0 (-20.3)	71.2 (-3.2)	81.0 (+16.0)	93.6 (-0.8)	71.4 (+21.9)	14,475,794
	$B^{(k=3)}$+N+H	68.5 (-12.7)	68.1 (-21.2)	69.0 (-5.4)	81.5 (+16.5)	94.1 (-0.3)	71.9 (+22.4)	15,682,834
	B+N+H	68.7 (-12.5)	68.2 (-21.1)	69.1 (-5.3)	81.5 (+16.5)	94.0 (-0.4)	72.0 (+22.5)	15,829,874
ResNet-18	No fine-tuning	80.4	87.9	74.0	64.4	92.9	49.3	0
	bias(H)	78.6 (-1.8)	82.7 (-5.2)	74.9 (+0.9)	71.0 (+6.6)	89.5 (-3.4)	58.9 (+9.6)	1,315
	bias(N+H)	78.8 (-1.6)	83.8 (-4.1)	74.4 (+0.4)	70.6 (+6.2)	89.1 (-3.8)	58.5 (+9.2)	1,699
	H	74.0 (-6.4)	75.4 (-12.5)	72.5 (-1.5)	76.4 (+12.0)	90.6 (-2.3)	66.1 (+16.8)	429,555
	N+H	72.1 (-8.3)	72.8 (-15.1)	71.5 (-2.5)	77.8 (+13.4)	91.8 (-1.1)	67.4 (+18.1)	597,875
	$B^{(k=2)}$+N+H	70.4 (-10.0)	71.5 (-16.4)	69.4 (-4.6)	79.7 (+15.3)	93.5 (+0.6)	69.5 (+20.2)	8,991,603
	$B^{(k=3)}$+N+H	70.0 (-10.4)	71.9 (-16.0)	68.2 (-5.8)	79.8 (+15.4)	94.1 (+1.2)	69.3 (+20.0)	11,091,315
	B+N+H	68.7 (-11.7)	69.8 (-18.1)	67.7 (-6.3)	80.0 (+15.6)	94.2 (+1.3)	69.6 (+20.3)	11,774,387
ERFNet	No fine-tuning	79.1	85.6	73.6	65.9	92.0	51.4	0
	bias(H)	76.4 (-2.7)	78.6 (-7.0)	74.2 (+0.6)	71.0 (+5.1)	87.4 (-4.6)	59.8 (+8.4)	1,315
	bias(N+H)	76.3 (-2.8)	78.3 (-7.3)	74.4 (+0.8)	71.2 (+5.3)	87.3 (-4.7)	60.1 (+8.7)	1,699
	H	71.2 (-7.9)	72.2 (-13.4)	70.3 (-3.3)	75.2 (+9.3)	89.6 (-2.4)	64.8 (+13.4)	429,555
	N+H	68.9 (-10.2)	69.3 (-16.3)	68.6 (-5.0)	76.6 (+10.7)	90.4 (-1.6)	66.4 (+15.0)	597,875
	$B^{(k=2)}$+N+H	67.5 (-11.6)	68.6 (-17.0)	66.4 (-7.2)	79.1 (+13.2)	92.9 (+0.9)	68.9 (+17.5)	5,277,215
	$B^{(k=3)}$+N+H	66.9 (-12.2)	67.4 (-18.2)	66.5 (-7.1)	79.3 (+13.4)	92.7 (+0.7)	69.3 (+17.9)	5,474,847
	B+N+H	66.5 (-12.6)	68.0 (-17.6)	65.0 (-8.6)	79.0 (+13.1)	92.9 (+0.9)	68.7 (+17.3)	5,561,695

Table 5. The base model is trained on CULane, and results are shown after fine-tuning different components on AssistTaxi. Precision, Recall, and F1-score are reported at a confidence threshold of 0.5. For each setting, we show source (CULane) and target (AssistTaxi) performance, with relative *drops* from the CULane no-finetuning baseline and *gains* over the AssistTaxi zero-shot baseline indicated in parentheses.

Backbone	**FT Config**	**CULane (Src)**			**AssistTaxi (Tgt)**			**#Params**
		F1 (drop)	Prec (drop)	Rec (drop)	F1 (gain)	Prec (gain)	Rec (gain)	
DLA-34	No fine-tuning	81.2	89.3	74.4	0.0	0.0	0.0	0
	bias(H)	19.3 (-61.9)	48.6 (-40.7)	12.1 (-62.3)	17.4 (+17.4)	82.9 (+82.9)	9.7 (+9.7)	1,330
	bias(N+H)	20.5 (-60.7)	48.6 (-40.7)	12.9 (-61.5)	18.7 (+18.7)	77.5 (+77.5)	10.7 (+10.7)	1,714
	H	2.0 (-79.2)	2.4 (-86.9)	1.7 (-72.7)	77.8 (+77.8)	80.5 (+80.5)	75.4 (+75.4)	432,450
	N+H	0.6 (-80.6)	10.9 (-78.4)	0.3 (-74.1)	82.1 (+82.1)	85.3 (+85.3)	79.1 (+79.1)	600,770
	$B^{(k=2)}$+N+H	16.6 (-64.6)	83.8 (-5.5)	9.2 (-65.2)	93.7 (+93.7)	96.3 (+96.3)	91.3 (+91.3)	14,475,794
	$B^{(k=3)}$+N+H	2.8 (-78.4)	72.6 (-16.7)	1.4 (-73.0)	92.5 (+92.5)	93.6 (+93.6)	91.5 (+91.5)	15,682,834
	B+N+H	3.1 (-78.1)	75.5 (-13.8)	0.7 (-73.7)	94.8 (+94.8)	97.3 (+97.3)	92.5 (+92.5)	15,829,874
ResNet-18	No fine-tuning	80.4	87.9	74.0	0.0	0.0	0.0	0
	bias(H)	19.2 (-61.2)	74.2 (-13.7)	11.0 (-63.0)	21.2 (+21.2)	70.9 (+70.9)	12.5 (+12.5)	1,315
	bias(N+H)	16.2 (-64.2)	70.4 (-17.5)	9.1 (-64.9)	19.0 (+19.0)	66.9 (+66.9)	11.1 (+11.1)	1,699
	H	5.1 (-75.3)	61.2 (-26.7)	2.6 (-71.4)	76.9 (+76.9)	79.7 (+79.7)	74.3 (+74.3)	429,555
	N+H	5.4 (-75.0)	61.8 (-26.1)	2.8 (-71.2)	82.8 (+82.8)	84.7 (+84.7)	81.0 (+81.0)	597,875
	$B^{(k=2)}$+N+H	13.1 (-67.3)	85.6 (-2.3)	7.1 (-66.9)	90.6 (+90.6)	91.9 (+91.9)	89.3 (+89.3)	8,991,603
	$B^{(k=3)}$+N+H	16.3 (-64.1)	37.5 (-50.4)	10.4 (-63.6)	93.5 (+93.5)	94.9 (+94.9)	92.1 (+92.1)	11,091,315
	B+N+H	16.3 (-64.1)	85.3 (-2.6)	9.0 (-65.0)	94.5 (+94.5)	97.2 (+97.2)	91.9 (+91.9)	11,774,387
ERFNet	No fine-tuning	79.1	85.6	73.6	0.0	0.0	0.0	0
	bias(H)	14.6 (-64.5)	50.6 (-35.0)	8.5 (-65.1)	1.2 (+1.2)	10.3 (+10.3)	0.7 (+0.7)	1,315
	bias(N+H)	17.5 (-61.6)	54.7 (-30.9)	10.4 (-63.2)	1.7 (+1.7)	25.7 (+25.7)	1.0 (+1.0)	1,699
	H	0.8 (-78.3)	49.4 (-36.2)	0.4 (-73.2)	80.1 (+80.1)	85.2 (+85.2)	75.6 (+75.6)	429,555
	N+H	0.8 (-78.3)	34.6 (-51.0)	0.4 (-73.2)	86.6 (+86.6)	88.3 (+88.3)	85.0 (+85.0)	597,875
	$B^{(k=2)}$+N+H	11.3 (-67.8)	84.5 (-1.1)	6.1 (-67.5)	92.7 (+92.7)	95.1 (+95.1)	90.5 (+90.5)	5,277,215
	$B^{(k=3)}$+N+H	6.1 (-73.0)	85.7 (+0.1)	3.2 (-70.4)	90.9 (+90.9)	92.3 (+92.3)	89.6 (+89.6)	5,474,847
	B+N+H	3.7 (-75.4)	90.6 (+5.0)	1.9 (-71.7)	92.8 (+92.8)	94.9 (+94.9)	90.8 (+90.8)	5,561,695