

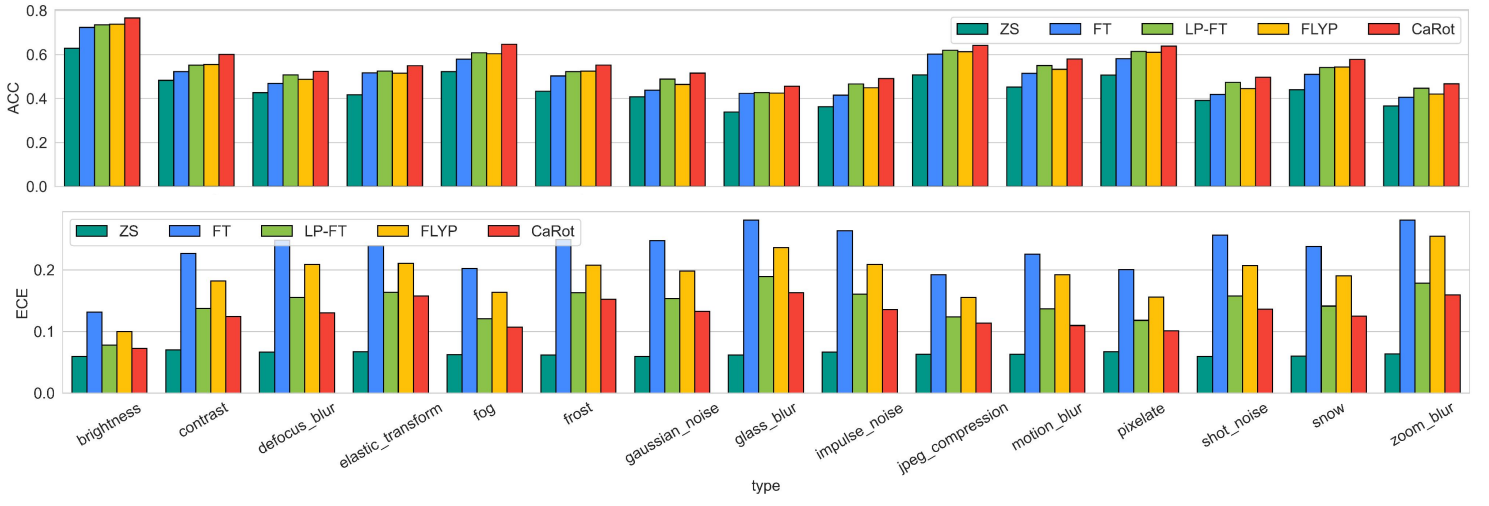


Figure 1. ImageNet-C.

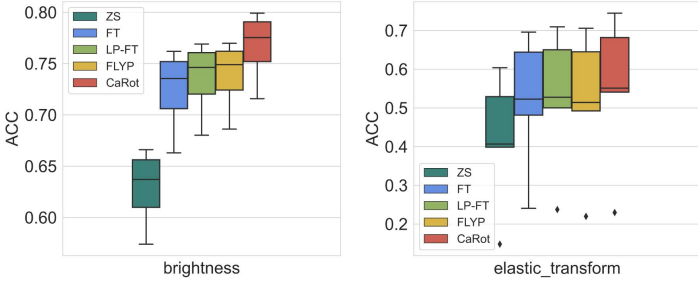


Figure 2. Brightness (left) and elastic transform (right) corruptions from ImageNet-C.

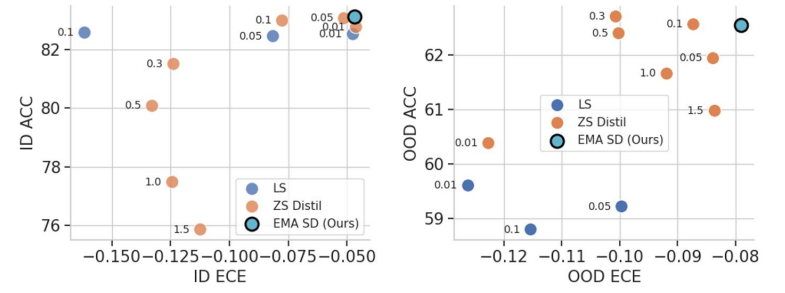


Figure 3. Ablation on training-time calibration.

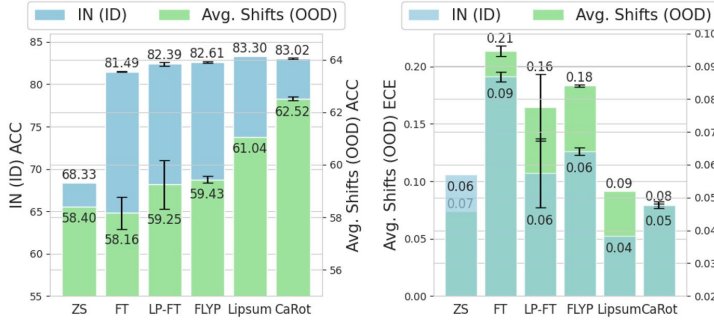


Figure 4. Main results repeated in three seeds.

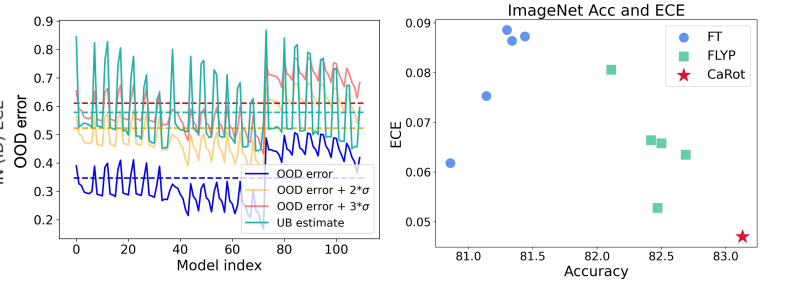


Figure 5. Error bound tightness. Figure 6. Acc. and ECE correlation.

Table 1. Ablation on $\sigma_{\min}$ constraint implementation.

	Time	IN (ID)		Avg. shifts (OOD)	
		Acc. $\uparrow$	ECE $\downarrow$	Acc. $\uparrow$	ECE $\downarrow$
SVD	$O(D^2N + D^3)$	83.05	0.0536	62.40	0.0770
Ours	$O(D^2N + 3D^2)$	83.13	0.0470	62.55	0.0791

Table 2. Ablation on orthogonal constraint (OC) and WiSE (W).

	OC	W	IN (ID)		Avg. shifts (OOD)	
			Acc. $\uparrow$	ECE $\downarrow$	Acc. $\uparrow$	ECE $\downarrow$
FT	-	-	81.53	0.0884	57.50	0.2186
	✓	-	81.45	0.0826	59.10	0.2051
	-	✓	82.16	0.0820	61.22	0.1920
	✓	✓	82.03	0.0770	61.97	0.1829
FLYP	-	-	82.69	0.0635	59.46	0.1831
	✓	-	82.51	0.0651	59.51	0.1803
	-	✓	82.98	0.0798	61.27	0.1788
	✓	✓	82.80	0.0627	61.41	0.1682

Table 3. Multi-source domain generalization benchmarks.

Train val. select Method	PACS		VLCS	
	Acc. $\uparrow$	ECE $\downarrow$	Acc. $\uparrow$	ECE $\downarrow$
ERM	90.5 $\pm$ 1.3	0.049 $\pm$ 0.006	80.1 $\pm$ 0.4	0.141 $\pm$ 0.011
GroupDRO	87.7 $\pm$ 0.9	0.067 $\pm$ 0.008	77.8 $\pm$ 0.3	0.161 $\pm$ 0.009
SelfReg	89.7 $\pm$ 2.0	0.050 $\pm$ 0.017	79.4 $\pm$ 0.3	0.140 $\pm$ 0.013
IB ERM	86.3 $\pm$ 2.5	0.067 $\pm$ 0.016	79.0 $\pm$ 0.3	0.146 $\pm$ 0.010
CAD	68.8 $\pm$ 9.9	0.128 $\pm$ 0.031	70.1 $\pm$ 6.2	0.151 $\pm$ 0.003
Causal CORAL	88.8 $\pm$ 1.5	0.054 $\pm$ 0.009	79.6 $\pm$ 0.3	0.142 $\pm$ 0.004
EQRm	88.6 $\pm$ 1.0	0.068 $\pm$ 0.010	79.9 $\pm$ 0.7	0.131 $\pm$ 0.011
ERM++	95.0 $\pm$ 0.6	0.025 $\pm$ 0.003	81.6 $\pm$ 0.1	0.118 $\pm$ 0.002
ERM++ w/ CaRot	96.2 $\pm$ 0.5	0.013 $\pm$ 0.000	81.1 $\pm$ 0.2	0.112 $\pm$ 0.002
Test oracle select Method	PACS		VLCS	
	Acc. $\uparrow$	ECE $\downarrow$	Acc. $\uparrow$	ECE $\downarrow$
ERM	85.6 $\pm$ 1.0	0.085 $\pm$ 0.005	78.4 $\pm$ 0.3	0.170 $\pm$ 0.000
GroupDRO	87.0 $\pm$ 1.1	0.068 $\pm$ 0.007	77.3 $\pm$ 0.2	0.180 $\pm$ 0.002
SelfReg	87.2 $\pm$ 1.2	0.062 $\pm$ 0.005	79.1 $\pm$ 0.9	0.148 $\pm$ 0.016
IB ERM	83.3 $\pm$ 1.2	0.082 $\pm$ 0.008	75.7 $\pm$ 0.8	0.166 $\pm$ 0.006
CAD	68.2 $\pm$ 8.6	0.139 $\pm$ 0.013	68.2 $\pm$ 4.9	0.169 $\pm$ 0.017
Causal CORAL	87.3 $\pm$ 1.1	0.069 $\pm$ 0.007	78.3 $\pm$ 0.4	0.161 $\pm$ 0.007
EQRm	88.9 $\pm$ 0.8	0.066 $\pm$ 0.006	78.6 $\pm$ 0.5	0.159 $\pm$ 0.005
ERM++	95.6 $\pm$ 0.4	0.021 $\pm$ 0.003	80.7 $\pm$ 0.5	0.148 $\pm$ 0.007
ERM++ w/ CaRot	95.6 $\pm$ 0.3	0.018 $\pm$ 0.001	81.1 $\pm$ 0.1	0.100 $\pm$ 0.015