HIKVISION

ECCV TEL AVIV 2022

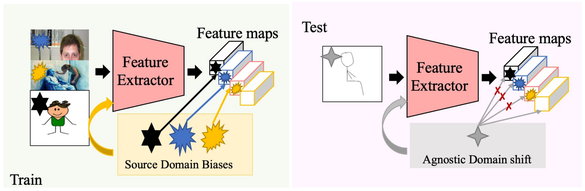
Attention Diversification for Domain Generalization

Rang Meng, Xianfeng Li, Weijie Chen, Shicai Yang, Jie Song, Xinchao Wang, Lei Zhang, Mingli Song, Di Xie, and Shiliang Pu

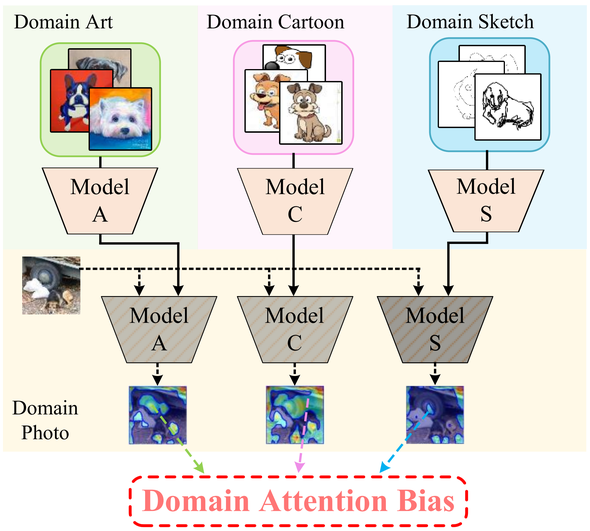
Motivation

◆ Background

Deep models trained on seen domains perform poorly on unseen domains for the seen/unseen domain shifts.



◆ Our Finding of Domain Attention Bias



We find that models trained on different domains have different attention bias

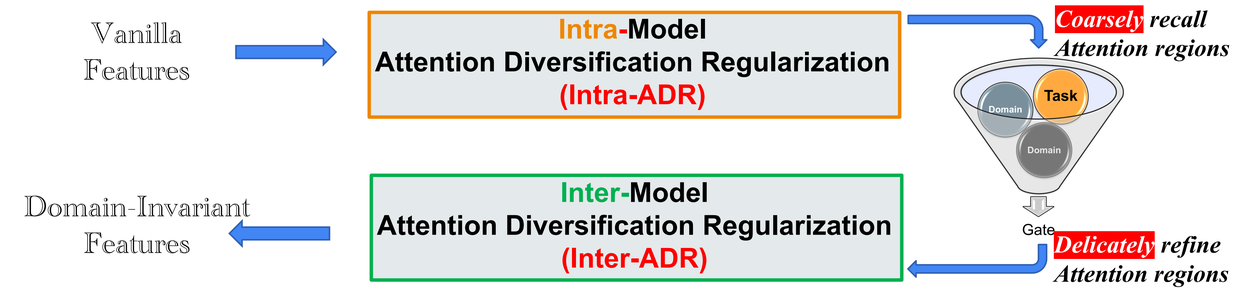
◆ Our Revisiting of DG from Maximum Entropy Principle

Maximum Entropy Principle: ***when estimating the probability distribution, we should select that distribution with the largest uncertainty under given constraints.***

Our Insight: ***when testing the unseen domains, each task-related attention is equally-useful (the maximum entropy)***

Methodology

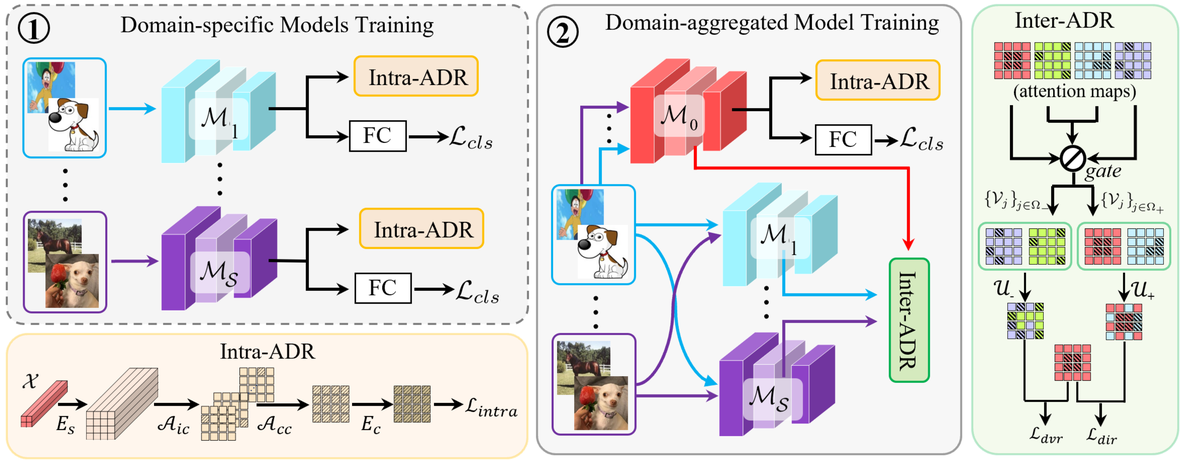
◆ Workflow of Our Attention Diversification Framework



◆ Training Scheme of Our Attention Diversification Framework

Intra-ADR forces different channels to concern on different regions and activates all the regions.

Inter-ADR uses a paradigm of "simulate, divide and assemble".



① Domain-specific Models Training ➔ Warmup step equipped with Intra-ADR and for "*simulate*" part in Inter-ADR.

② Domain-aggregated Model Training ➔ Main step equipped with Intra- and Inter-ADR for coarse-to-fine Attention Diversification.

Experiments

◆ Results

PACS

Methods	References	Art	Cartoon	Photo	Sketch	Avg.	Art	Cartoon	Photo	Sketch	Avg.
		ResNet-18					*ResNet-50*				
Baseline	-	79.0	74.3	94.9	71.4	79.9	86.2	78.7	97.6	70.6	83.2
MetaReg [1]	NeurIPS'18	83.7	77.2	95.5	70.3	81.7	87.2	79.2	97.6	70.3	83.6
MASF [12]	NeurIPS'19	80.2	77.1	94.9	71.6	81.0	82.8	80.4	95.0	72.2	82.6
Epi-FCR [26]	ICCV'19	82.1	77.0	93.9	73.0	81.5	-	-	-	-	-
JiGen [4]	CVPR'19	79.4	75.2	96.0	71.3	80.5	-	-	-	-	-
DMG [5]	ECCV'20	76.9	80.4	93.4	75.2	81.5	82.6	78.1	94.5	78.3	83.4
RSC [21]	ECCV'20	84.4	80.3	95.9	80.8	85.1	87.8	82.1	97.9	83.3	87.9
MixStyle [78]	ICLR'21	84.1	78.8	96.1	75.9	83.7	-	-	-	-	-
SelfReg [24]	ICCV'21	82.3	78.4	**96.2**	77.5	83.6	87.9	79.4	96.8	78.3	85.6
DAML [50]	CVPR'21	83.0	74.1	95.6	78.1	82.7	-	-	-	-	-
SagNet [42]	CVPR'21	83.6	77.7	95.5	76.3	83.3	81.1	75.4	95.7	77.2	82.3
FACT [65]	CVPR'21	85.4	78.4	95.2	79.2	84.5	**89.6**	81.7	96.8	84.4	88.1
Intra-ADR	Ours	82.4	79.4	95.3	82.3	84.9	87.7	81.2	97.1	83.8	87.5
I^2-ADR	Ours	82.9	80.8	95.0	83.5	85.6	88.5	83.2	95.2	**85.8**	88.2
MixStyle + Intra-ADR	Ours	**86.0**	80.3	96.0	84.4	86.7	88.6	83.2	98.0	85.2	88.7
MixStyle + I^2-ADR	Ours	85.3	**81.2**	95.4	**86.1**	**87.0**	87.7	**84.5**	**98.2**	85.6	**89.2**

Office Home

Methods	Ar	Cl	Pr	Rw	Avg.
	ResNet-18				
Baseline	57.8	52.7	73.5	74.8	64.7
RSC [21]	58.4	47.9	71.6	74.5	63.1
MixStyle [78]	58.7	53.4	74.2	75.9	65.5
SagNet [42]	60.2	45.4	70.4	73.4	62.3
FACT [65]	60.3	54.9	74.5	**76.6**	66.6
Intra-ADR	64.5	54.0	73.9	74.7	66.8
I^2-ADR	66.4	53.3	74.9	75.3	67.5
MixStyle + Intra-ADR	65.9	55.3	74.3	75.1	67.7
MixStyle + I^2-ADR	**66.8**	**56.8**	**75.3**	75.7	**68.7**

Methods	Ar	Cl	Pr	Rw	Avg.
	ResNet-50				
Baseline	61.3	52.4	75.8	76.6	66.5
MLDG [28]	61.5	53.2	75.0	77.5	66.8
RSC [21]	50.7	51.4	74.8	75.1	65.5
SelfReg [24]	63.6	53.1	76.9	78.1	67.9
SagNet [42]	63.4	54.8	75.8	78.3	68.1
Intra-ADR	67.3	54.1	78.8	78.8	69.8
I^2-ADR	70.3	55.1	80.7	79.2	71.4
MixStyle + Intra-ADR	69.5	55.9	80.6	80.4	71.4
MixStyle + I^2-ADR	**71.1**	**56.9**	**81.8**	**80.5**	**72.5**

DomainNet

Methods	References	Clipart	Infograph	Painting	Quickdraw	Real	Sketch	Avg.
		ResNet-18						
Baseline	-	57.1	17.6	43.2	13.8	54.9	39.4	37.6
MetaReg [1]	NeurIPS'18	53.7	**21.1**	**45.3**	10.6	**58.5**	42.3	38.6
DMG [5]	ECCV'20	**60.1**	18.8	44.5	**14.2**	54.7	41.7	**39.0**
Intra-ADR	Ours	57.3±0.1	14.9±0.3	42.8±0.2	12.2±0.4	52.9±0.5	46.0±0.2	37.7
I^2-ADR	Ours	57.3±0.3	15.2±0.3	44.1±0.1	12.1±0.4	53.9±0.6	46.7±0.2	38.2
MixStyle + Intra-ADR	Ours	57.4±0.2	15.3±0.1	43.3±0.2	12.3±0.4	53.5±0.3	46.5±0.2	38.1
MixStyle + I^2-ADR	Ours	57.4±0.4	15.7±0.2	44.7±0.1	12.3±0.4	54.4±0.2	**47.4±0.1**	38.7
		ResNet-50						
Baseline	-	62.2	19.9	45.5	13.8	57.5	44.4	40.5
MetaReg [1]	NeurIPS'18	59.8	**25.6**	**50.2**	11.5	**64.6**	50.1	43.6
MLDG [28]	AAAI'18	59.1±0.2	19.1±0.3	45.8±0.7	13.4±0.3	59.6±0.2	50.2±0.4	41.2
C-DANN [31]	ECCV'18	54.6±0.4	17.3±0.1	43.7±0.9	12.1±0.7	56.2±0.4	45.9±0.5	38.3
RSC [21]	ECCV'20	55.0±1.2	18.3±0.5	44.4±0.6	12.2±0.2	55.7±0.7	47.8±0.9	38.9
DMG [5]	ECCV'20	**65.2**	22.2	50.0	**15.7**	59.6	49.0	43.6
SagNet [42]	CVPR'21	57.7±0.3	19.0±0.2	45.3±0.3	12.7±0.5	58.1±0.5	48.8±0.2	40.3
SelfReg [24]	ICCV'21	60.7±0.1	21.6±0.1	49.4±0.2	12.7±0.1	60.7±0.1	51.7±0.1	42.8
Intra-ADR	Ours	63.6±0.1	20.0±0.1	49.4±0.1	14.8±0.3	60.0±0.4	**54.4±0.1**	43.7
I^2-ADR	Ours	64.4±0.2	20.2±0.6	49.2±0.5	15.0±0.2	61.6±0.4	53.3±0.1	44.0
MixStyle + Intra-ADR	Ours	63.9±0.1	20.1±0.5	49.4±0.2	15.0±0.4	60.4±0.3	**54.4±0.1**	43.9
MixStyle + I^2-ADR	Ours	64.1±0.1	20.4±0.2	49.2±0.4	15.1±0.2	61.3±0.4	54.3±0.4	**44.1**

Ablation Study

Method	$\mathcal{L}_{intra}$	$\mathcal{L}_{dir}$	$\mathcal{L}_{dvr}$	Art	Cartoon	Photo	Sketch	Avg.
I^2-ADR	✓	-	-	82.4	79.4	**95.3**	82.3	84.9
	-	✓	✓	82.3	80.0	95.1	82.6	85.0
	✓	✓	-	82.7	80.5	95.0	83.2	85.4
	✓	-	✓	82.5	80.2	95.1	82.9	85.2
	✓	✓	✓	**82.9**	**80.8**	95.0	**83.5**	**85.6**

Method	E_s	E_c	Art	Cartoon	Photo	Sketch	Avg.
Intra-ADR	-	-	81.3	77.3	94.7	78.8	83.0
	-	✓	80.0	77.2	**96.0**	80.9	83.5
	✓	-	81.9	79.3	95.5	79.3	84.0
	✓	✓	**82.4**	**79.4**	95.3	**82.3**	**84.9**

◆ Attention Visualization