CANU-ReID: A Conditional Adversarial Network for Unsupervised person Re-IDentification

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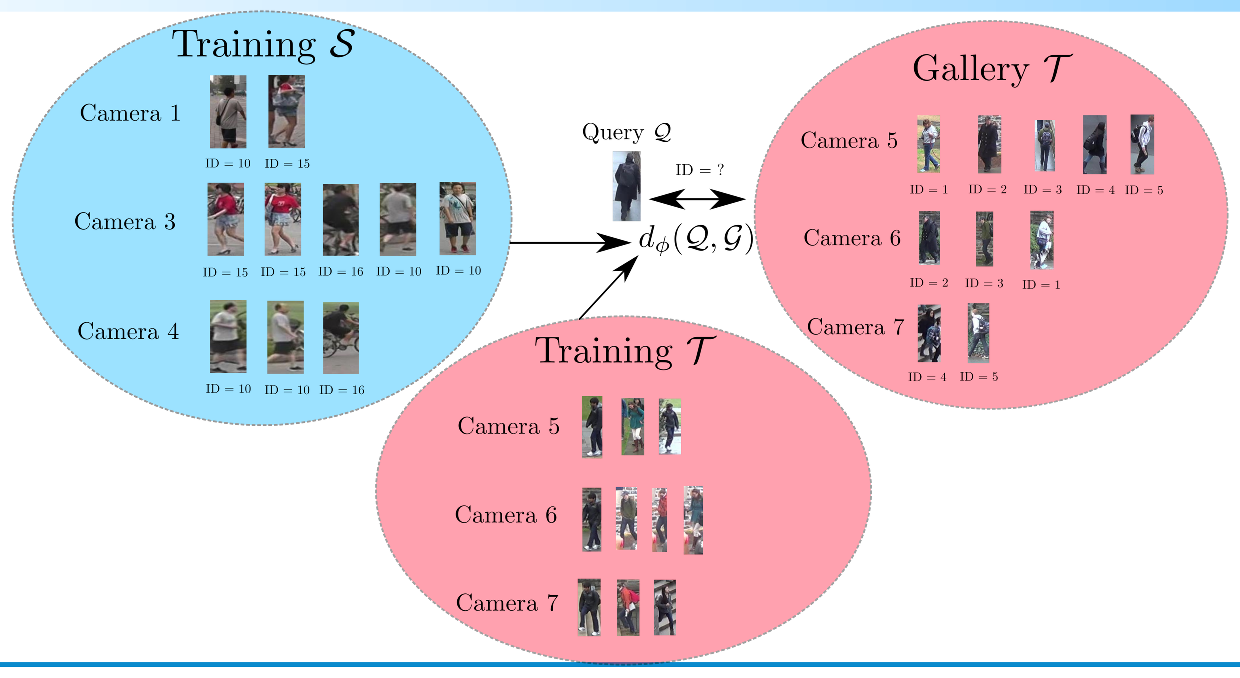
Motivation

We adress the problem of unsupervised person Re-ID in the context of the *Clustering and Finetuning* framework via a **Camera adversarially-guided clustering**, highlight and adress the problem of **negative transfer** via a **conditioned adversarial** approach.

Clustering and Finetuning for Unsupervised Person Re-ID



Unsupervised Person Re-ID: Domain Adaptation setting for Person Re-ID.

Clustering and Finetuning: Recent works in Unsupervised Person Re-ID are based on this framework (SSG[1], MMT[2]):

0 - Source Pretraining: ϕ is pretrained using source $\mathcal{S}$ in a supervised fashion. $\mathcal{S}$ is then discarded.

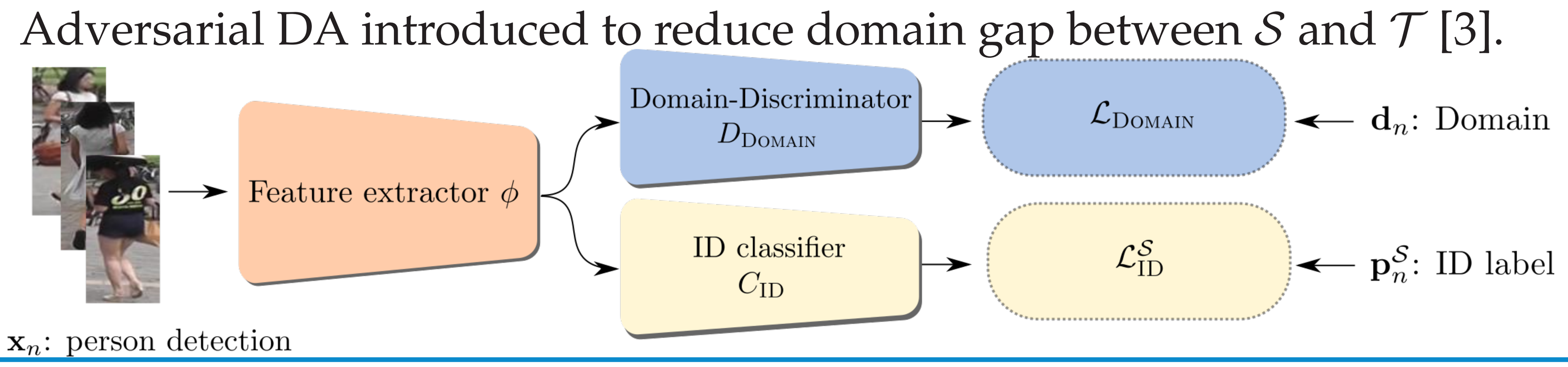
1 - Clustering step: runs a clustering algorithm on $\mathcal{T}$ in the embedding of ϕ (frozen). Generates pseudo-ID labels on $\mathcal{T}$: $\tilde{\mathbf{p}}^{\mathcal{T}}$.

2 - Finetuning step: ϕ is finetuned for a few epochs suppervised by $\mathcal{L}_{\text{PS-ID}}$ and using pseudo-ID labels $\tilde{\mathbf{p}}^{\mathcal{T}}$ as ID-annotation.

3 - Return to 1 Clustering/Finetuning steps alternate until we reach convergence.

Adversarial Domain Adaptation (DA)

Adversarial DA introduced to reduce domain gap between $\mathcal{S}$ and $\mathcal{T}$ [3].



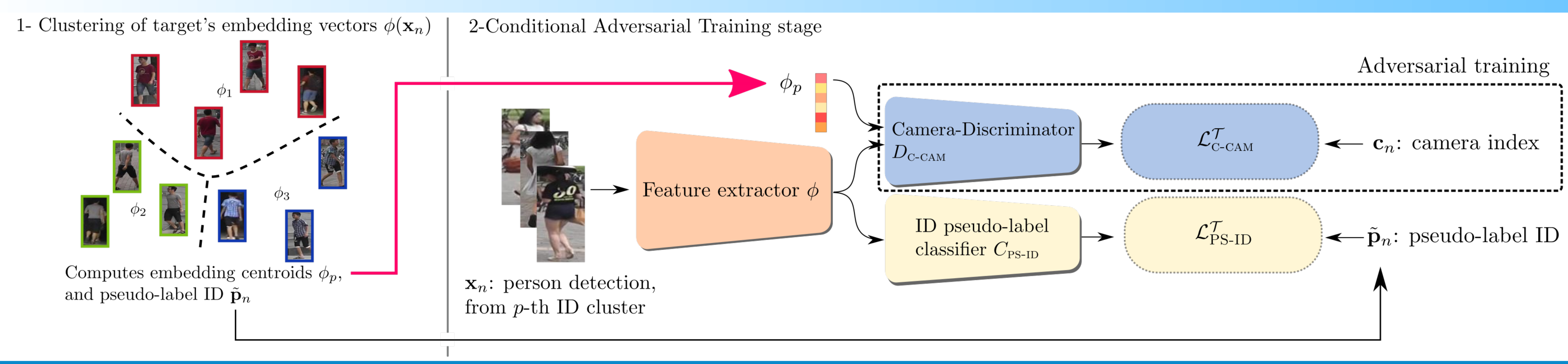
Adversarial training:

$$\min_{\phi, C_{ID}} \max_{D_{\text{DOMAIN}}} \mathcal{L}^{\mathcal{S}}_{\text{ID}}(\phi, C_{\text{ID}}) - \mu \mathcal{L}_{\text{DOMAIN}}(D_{\text{DOMAIN}})$$

Negative Transfer

Adversarial framework → *Negative Transfer*:
Discriminator learns **ID-related** instead of **domain-related features**, and degrades ϕ discriminative power.
Happens with **different ID prior** distributions across domains (cameras in our case).

Training Pipeline



Camera adversarially guided clustering: the discriminator is trained to retrieve camera info.

Conditioned adversarial strategy: pseudo-ID information is provided to $D_{\text{C-CAM}}$ to handle negative transfer:

$$\min_{\phi, C_{\text{PS-ID}}} \max_{D_{\text{C-CAM}}} \mathcal{L}^{\mathcal{T}}_{\text{PS-ID}}(\phi, C_{\text{PS-ID}}) - \mu \mathcal{L}^{\mathcal{T}}_{\text{C-CAM}}(\phi, D_{\text{C-CAM}}),$$

Can be used with any *Clustering* and *Finetuning* method: **CANU**-SSG, **CANU**-MMT.

Comparison to State of the Art

Method	Mkt ▶ Duke		Duke ▶ Mkt	
	R1	mAP	R1	mAP
SPGAN	41.1	22.3	51.5	22.8
Co-teaching	77.6	61.7	87.8	71.7
SSG [1]	73.0	53.4	80.0	58.3
CANU-SSG (ours)	**76.1**	**57.0**	**83.3**	**61.9**
MMT [2]	80.2	67.2	91.7	79.3
CANU-MMT (ours)	**83.3**	**70.3**	**94.2**	**83.0**

CANU on the Mkt ▶ Duke and Duke ▶ Mkt.

Method	Mkt ▶ MSMT		Duke ▶ MSMT	
	R1	mAP	R1	mAP
PTGAN	10.2	2.9	11.8	3.3
ENC	25.3	8.5	30.2	10.2
SSG [1]	31.6	13.2	32.2	13.3
CANU-SSG (ours)	**45.5**	**19.1**	**43.3**	**17.9**
MMT [2]	51.6	26.6	59.0	32.0
CANU-MMT (ours)	**61.7**	**34.6**	**66.9**	**38.3**

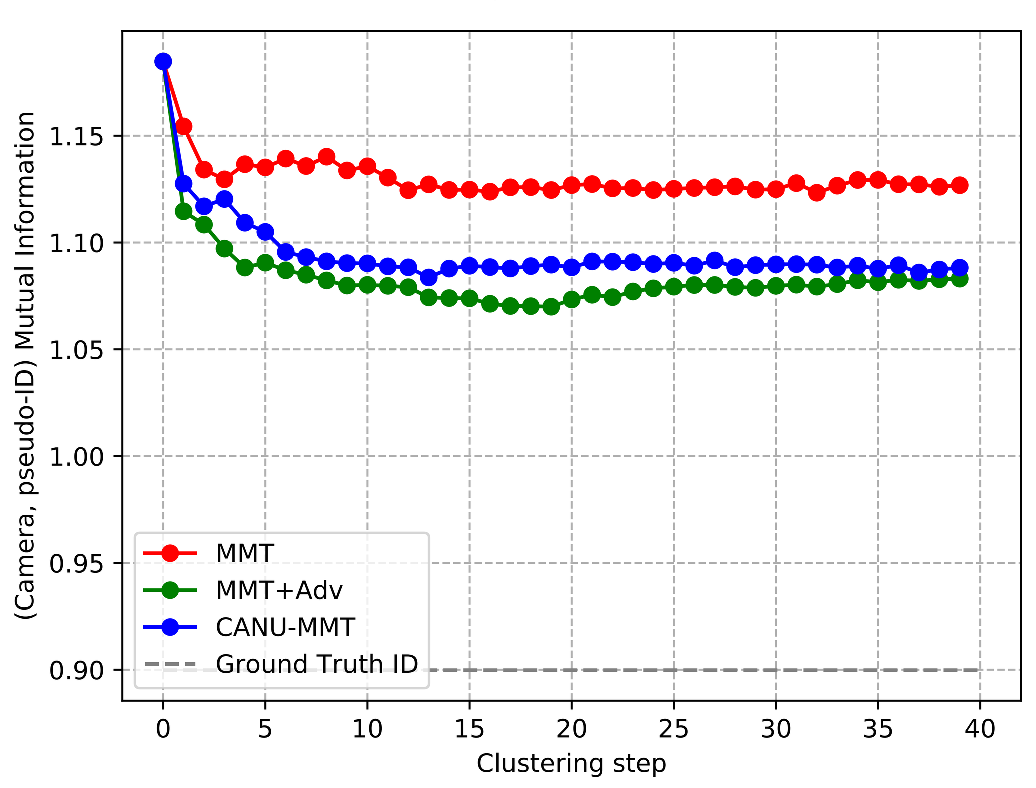
CANU on the Mkt ▶ MSMT and Duke ▶ MSMT.

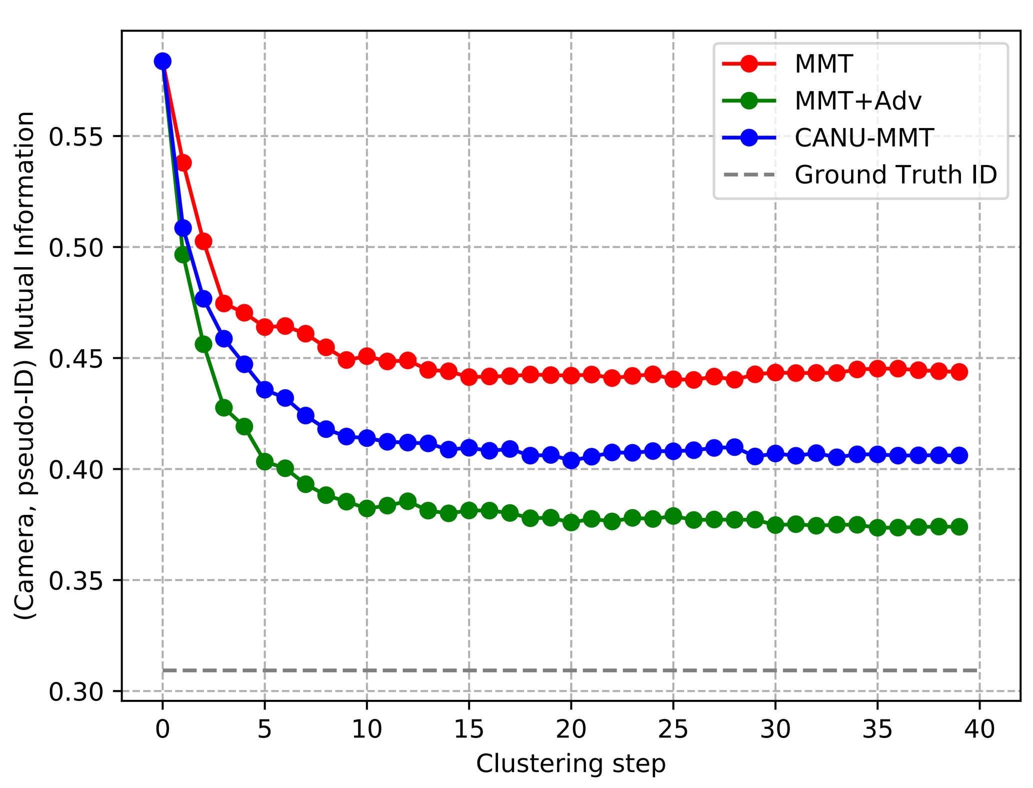
Impact of Negative Transfer

Conditioned **CANU** compared with standard camera adversarial implementation:

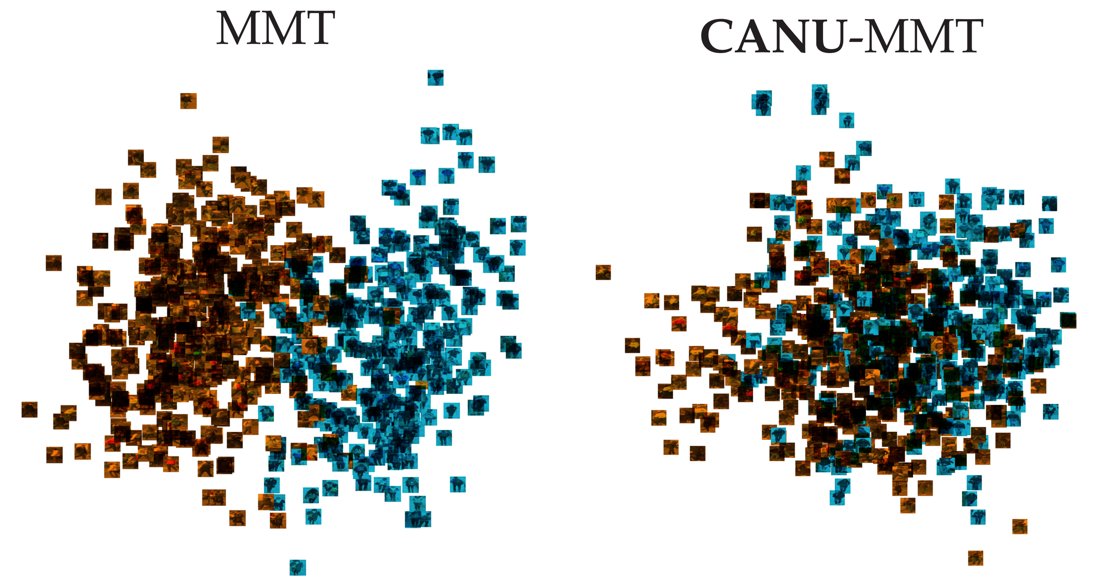
Method	Mkt ▶ Duke		Duke ▶ Mkt	
	R1	mAP	R1	mAP
SSG [1]	73.0	53.4	80.0	58.3
SSG+Adv.	75.4	56.4	**83.8**	**62.7**
CANU-SSG	**76.1**	**57.0**	83.3	61.9
MMT [2]	80.2	67.2	91.7	79.3
MMT+Adv.	82.6	70.3	93.6	82.2
CANU-MMT	**83.3**	**70.3**	**94.2**	**83.0**

Camera and pseudo-ID labels mutual information





Embedding Visualisation



Embedding PCA with Mkt ▶Duke for camera 3 (in blue) and 6 (in orange).

References

[1] Yang Fu, Yunchao Wei, Guanshuo Wang, Yuqian Zhou, Honghui Shi, and Thomas S Huang. Self-similarity grouping: A simple unsupervised cross domain adapt. approach for person re-id. In *ICCV*, 2019.

[2] Yixiao Ge, Dapeng Chen, and Hongsheng Li. Mutual mean-teaching: Pseudo label refinery for unsupervised domain adaptation on person re-identification. *ICLR*, 2020.

[3] Yaroslav Ganin, Evgeniya Ustinova, Hana Ajakan, Pascal Germain, Hugo Larochelle, François Laviolette, Mario Marchand, and Victor Lempitsky. Domain-adversarial training of neural nets. *JMLR*, 2016.

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