Semi-supervised Person Re-identification by Attribute Similarity Guidance

Peixian Hong, Ancong Wu, Wei-Shi Zheng
Sun Yat-sen University, China

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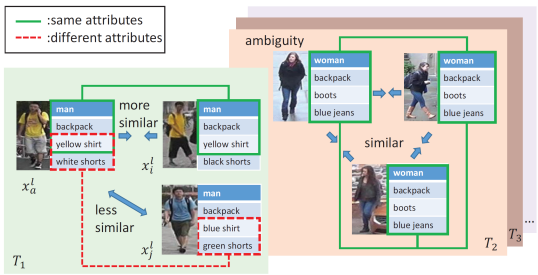
1.Introduction

The problem & Motivation

- ✓ Supervised person re-identification (Re-ID) requires time-consuming annotation. To reduce the labeling cost, we study the semi-supervised Re-ID.
- ✓ As pedestrian attribute is much easier to be annotated and contains coarse semantic knowledge of degree of similarity between different persons, we exploit it as auxiliary information.
- ✓ Ambiguity exists in pedestrian attribute that different persons may have very similar attributes.



Our Method

- ✓ Attribute similarity guidance loss by selective attribute similarity preservation.
- ✓ Attribute-guided self training framework.

2. Methodology

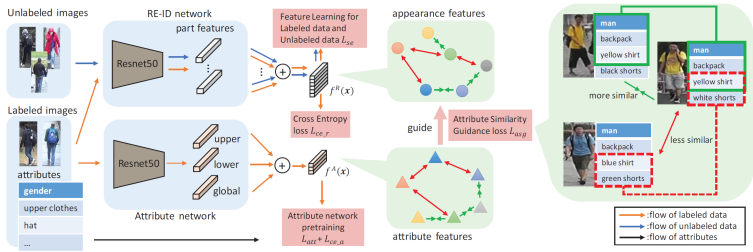
Guiding RE-ID Network using Attribute Similarity

$$\min \left| s^R_{a,i}/s^R_{a,j} - s^A_{a,i}/s^A_{a,j} \right|$$

$$L_{asg} = \begin{cases} \sum_{(a,i,j)\in\mathbb{N}} \left| \frac{s^R_{a,i}}{s^R_{a,j}} - \frac{s^A_{a,i}}{s^A_{a,j}} \right|, & (s^R_{a,i} - s^R_{a,j})(s^A_{a,i} - s^A_{a,j}) < 0 \\ 0, & (s^R_{a,i} - s^R_{a,j})(s^A_{a,i} - s^A_{a,j}) \geq 0 \end{cases}$$

Attribute similarity guidance loss

Selective attribute similarity preservation



Attribute-Guided Self Training Framework

✓ Memory-based feature learning

$$L^m = -\log \frac{\sum_{\mathbf{v}^u_j \in K^u_i} e^{-s\|f^R(\mathbf{x}^u_i) - \mathbf{v}^u_j\|_2^2}}{\sum_{j=1,j\neq i}^{n_u} e^{-s\|f^R(\mathbf{x}^u_i) - \mathbf{v}^u_j\|_2^2} + \sum_{\mathbf{v}^l_j \in K^l_i} e^{-s\|f^R(\mathbf{x}^u_i) - \mathbf{v}^l_j\|_2^2}}$$

✓ Clustering-based feature learning

$$L^c = \left[\|f^R(\mathbf{x}^u_a) - f^R(\mathbf{x}^u_p)\|_2^2 - \|f^R(\mathbf{x}^u_a) - f^R(\mathbf{x}^u_n)\|_2^2 + m\right]_+ + \left[\|f^R(\mathbf{x}^u_a) - f^R(\mathbf{x}^l_p)\|_2^2 - \|f^R(\mathbf{x}^u_a) - f^R(\mathbf{x}^l_n)\|_2^2 + m\right]_+$$

✓ Dynamic Weighted Optimizing

$$L_{se} = \frac{1}{U}\sum_{i=1}^{U} L^m_i + \frac{1}{U}\sum_{a=1}^{U} L^c_a$$

$$L = aL_{guide} + (1-a)L_{se}$$

2. Experimental results

Experiment settings

randomly selected 40 identities as labeled data and the remaining identities served as unlabeled data

results

source dataset	Market-1501				
target dataset	DukeMTMC				
Methods	labeled IDs	R-1	R-5	R-10	mAP
LSRO [6]	40 IDs	27.1	40.3	47.0	9.0
All-in-one [27]	40 IDs	43.5	58.3	64.3	21.1
Pseudo label [22]	40 IDs	45.2	60.2	66.7	23.5
TCP [3]	40 IDs	65.8	78.2	82.5	44.4
EDS [5]	40 IDs	66.1	78.6	82.1	44.3
PAUL [12]	40 IDs	61.9	74.6	78.9	40.3
SSG [15]	40 IDs	73.8	83.0	86.7	54.3
Ours	40 IDs	75.2	84.0	87.2	55.9
source dataset	DukeMTMC				
target dataset	Market-1501				
Methods	labeled IDs	R-1	R-5	R-10	mAP
LSRO [6]	40 IDs	37.2	54.1	60.7	12.6
All-in-one [27]	40 IDs	52.4	69.6	75.6	21.3
Pseudo label [22]	40 IDs	54.1	71.7	78.1	24.4
TCP [3]	40 IDs	75.4	88.8	92.6	48.1
EDS [5]	40 IDs	72.4	87.2	90.7	45.0
PAUL [12]	40 IDs	69.7	82.9	87.7	41.2
SSG [15]	40 IDs	82.3	92.0	94.5	61.6
Ours	40 IDs	84.4	92.9	95.1	63.7

source dataset	-				
target dataset	DukeMTMC				
Methods	labeled IDs	R-1	R-5	R-10	mAP
LSRO [6]	40 IDs	22.9	35.7	42.3	8.8
All-in-one [27]	40 IDs	32.5	48.6	56.7	16.7
Pseudo label [22]	40 IDs	40.6	56.5	63.8	21.3
TCP [3]	40 IDs	51.9	67.4	72.3	31.1
EDS [5]	40 IDs	53.2	68.2	73.8	30.1
PAUL [12]	40 IDs	51.1	67.5	73.9	29.7
SSG [15]	40 IDs	65.6	78.0	81.6	46.0
Ours	40 IDs	71.9	81.4	84.7	51.5
MVC [4]	1/3 of all IDs	55.7	-	-	37.8
Ours	1/3 of all IDs	76.7	86.3	88.6	58.1
source dataset	-				
target dataset	Market-1501				
Methods	labeled IDs	R-1	R-5	R-10	mAP
LSRO [6]	40 IDs	33.2	51.6	60.4	11.5
All-in-one [27]	40 IDs	44.4	66.0	73.9	19.2
Pseudo label [22]	40 IDs	46.7	67.2	75.2	21.7
TCP [3]	40 IDs	60.7	77.2	83.1	32.1
EDS [5]	40 IDs	50.3	68.0	75.8	24.2
PAUL [12]	40 IDs	51.9	68.3	75.0	24.4
SSG [15]	40 IDs	70.9	85.0	89.8	46.2
Ours	40 IDs	78.1	89.1	92.0	52.7
MVC [4]	1/3 of all IDs	75.3	-	-	52.6
Ours	1/3 of all IDs	87.0	94.1	96.2	66.6

Table 1: Comparison with related methods

source dataset	-		-		source dataset	DukeMTMC		Market-1501	
target dataset	Market-1501		DukeMTMC		target dataset	Market-1501		DukeMTMC	
method	R-1	mAP	R-1	mAP	method	R-1	mAP	R-1	mAP
attribute net	50.5	26.8	44.0	23.0	attribute net	62.4	34.9	57.9	36.8
reid net	60.4	34.3	51.2	30.2	reid net	71.7	44.2	63.8	42.4
reid net + ASG	65.3	37.3	57.6	36.3	reid net + ASG	73.6	45.3	65.8	44.5
reid net + ASG (w/o ASP)	57.0	30.6	48.3	27.4	reid net + ASG (w/o ASP)	72.0	43.6	64.0	42.8
reid net + ASG + SE	78.1	52.7	71.9	51.5	reid net + ASG + SE	84.4	63.7	75.2	55.9

Table 2: Ablation study

source dataset	DukeMTMC		Market-1501	
target dataset	Market-1501		DukeMTMC	
known identities	R-1	mAP	R-1	mAP
20	82.8	59.4	72.3	53.9
40	84.4	63.7	75.2	55.9
80	85.5	65.5	76.1	56.2
fully supervised	93.3	78.3	83.9	70.3

Table 3: Analysis on the number of known identities