Re-ranking Person Re-identification with *k*-reciprocal Encoding

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Introduction

Goal

Improves the person re-identification (re-ID) performance by re-ranking

Motivation

If a gallery image is similar to the probe in the *k*-reciprocal nearest neighbors, it is more likely to be a true match

Method

- Novel k-reciprocal feature
- Computes the feature distance using Jaccard distance
- Weighted aggregation of the original and Jaccard distance
- Does not require any human interaction or annotated data

Outcome

- The re-ranking process can be easily performed by vector comparison
- Can be applied to any person re-ID ranking result
- Improves the person re-ID performance on 4 datasets
- A new training/testing protocol on CUHK03

The New training/testing Protocol on CUHK03

Evaluation

- ✓ Cross-camera search
- ✓ Fixed train/test partition
- ✓ Multiple ground truths in the gallery
- ✓ Train: 767 IDs, 7,368 images
- ✓ Gallery : 700 IDs, 5,328 images, Query: 1,400 images

The Proposed Method

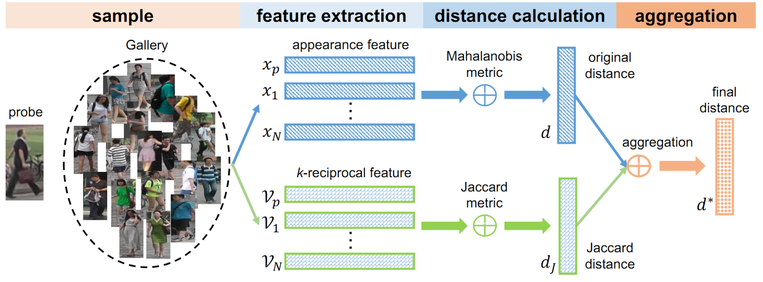

Figure 1. The proposed re-ranking framework.

K-reciprocal neighbors

$$\mathcal{R}(p,k) = \{(g_i \in N(p,k)) \cap (p \in N(g_i,k))\}$$

K-reciprocal neighbors expansion

$$\mathcal{R}^*(p,k) \leftarrow \mathcal{R}(p,k) \cup \mathcal{R}(q,\tfrac{1}{2}k)$$

$$s.t.\ \left|\mathcal{R}(p,k) \cap \mathcal{R}(q,\tfrac{1}{2}k)\right| \geqslant \tfrac{2}{3}\left|\mathcal{R}(q,\tfrac{1}{2}k)\right|,$$

$$\forall q \in \mathcal{R}(p,k)$$

Figure 2. The k-reciprocal neighbors expansion process.

K-reciprocal feature

$$\mathcal{V}_{p,g_i} = \begin{cases} 1 & \text{if } g_i \in \mathcal{R}^*(p,k) \\ 0 & \text{otherwise.} \end{cases}$$

Jaccard distance

$$d_J(p,g_i) = 1 - \frac{|\mathcal{R}^*(p,k) \cap \mathcal{R}^*(g_i,k)|}{|\mathcal{R}^*(p,k) \cup \mathcal{R}^*(g_i,k)|}$$

Final distance

$$d^*(p,g_i) = (1-\lambda)d_J(p,g_i) + \lambda d(p,g_i)$$

Results and Evaluation

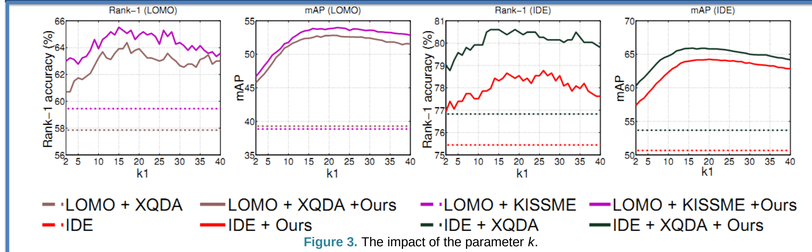

Figure 3. The impact of the parameter *k*.

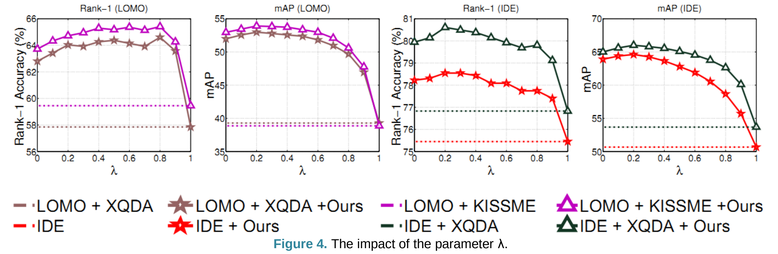

Figure 4. The impact of the parameter λ.

Methods	Rank@1	mAP
CAD [1]	48.24	24.43
SCSP [2]	51.90	26.35
DNS [3]	61.02	35.68
Gated [4]	65.88	39.55
BOW [5]	35.84	14.75
BOW+Ours	39.85	19.90
LOMO+XQDA [6]	43.56	22.44
LOMO+XQDA+Ours	48.34	32.21
IDE(C)	55.87	31.34
IDE(C)+Ours	58.79	42.06
IDE(R)	72.54	46.00
IDE(R)+AQE	73.20	50.14
IDE(R)+CDM	73.66	49.53
IDE(R)+Ours	74.85	59.87
IDE(R)+XQDA	71.41	48.89
IDE(R)+XQDA+Ours	75.14	61.87
IDE(R)+KISSME	73.60	49.05
IDE(R)+KISSME+Ours	77.11	63.63

Table 1. Results on Market-1501.

Methods	Rank@1	mAP
LOMO+XQDA	14.8	13.6
LOMO+XQDA+Ours	19.1	20.8
IDE(C)	15.6	14.9
IDE(C)+Ours	19.1	21.3
IDE(R)	22.2	21.0
IDE(R)+Ours	26.6	28.9
IDE(R)+XQDA	32.0	29.6
IDE(R)+XQDA+Ours	38.1	40.3

Table 3. Results on CUHK03.

Methods	Rank@1	mAP
LOMO+XQDA	31.82	17.00
LOMO+XQDA+Ours	33.99	23.20
IDE(C)	61.72	41.17
IDE(C)+Ours	62.78	51.47
IDE(R)	62.73	44.07
IDE(R)+Ours	65.61	57.94
IDE(R)+XQDA	70.51	55.12
IDE(R)+XQDA+Ours	73.94	68.45

Table 4. Results on MARS.

Methods	Rank@1	mAP
LOMO+XQDA	31.82	17.00
LOMO+XQDA+Ours	33.99	23.20
IDE(C)	61.72	41.17
IDE(C)+Ours	62.78	51.47

Table 2. Results on PRW.

Code is available

Figure 5. Example results of re-ranking method.

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