Dense Invariant Feature Based Support Vector Ranking for Person Re-identification

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Person Re-identification (ReID)

- Image Search
Person Re-identification (ReID)

- Person Re-identification

Introduction
Motivation
The SVR Alg.
Experiments
Summary & Future Work

Cam-a

Cam-b

database

query
Non-overlapping Camera Views

Irrelevant negative samples, difficult to train classifiers
Difficulty

View/Pose Changes
Carried objects occlude the person appearance
Need illumination-invariant features or light-amending process
Large Intra-class Variations & Limited Samples for Learning
Finding Correspondence by Segmentation

M. Farenzena et al., “Person Re-Identification by Symmetry-Driven Accumulation of Local Features”, CVPR 2010.

Finding Correspondence by Detection


Finding Correspondence by Salience


Learning Transformation

W.S. Zheng et al., "Person re-identification by support vector ranking " , BMVC 2010.
Motivation

• A pose-invariant feature is important in representation of similarity of images in different views.

• Same features in different views usually located in adjacent area.

• Transformation learning is also important to person re-identification.
Flowchart of the Alg.

- Feature Extraction – dColorSIFT*
- Feature Expression – Dense Invariant Feature (DIF)
- Similarity Evaluation – Support Vector Ranking (SVR)

The Dense Invariant Feature

Densely-sample the images into patches.

Find the most similar patch of each patch of an image in the surrounding area of the other image of a pair.

Assemble the largest similarity of each patch into a feature for a pair of images.
The Dense Invariant Feature

Form a feature by finding the most similar patches from an image of view B for an image of view A.

Forward DIF

Form a feature by finding the most similar patches from images of view A for images of view B.

Backward DIF
The SVR Algorithm*

\[
\text{minimize: } V(\vec{w}, \vec{\xi}) = \frac{1}{2} \vec{w} \cdot \vec{w} + C \sum \xi_{i,j,k}
\]

subject to:
\[
\forall (d_i, d_j) \in r_1^*: \vec{w} \Phi(q_1, d_i) \geq \vec{w} \Phi(q_1, d_j) + 1 - \xi_{i,j,1}
\]
\[
\ldots
\]
\[
\forall (d_i, d_j) \in r_n^*: \vec{w} \Phi(q_n, d_i) \geq \vec{w} \Phi(q_n, d_j) + 1 - \xi_{i,j,n}
\]
\[
\forall i \forall j \forall k : \xi_{i,j,k} \geq 0
\]

Feature-Fusion for Ranking

Forward DIF: $F_{ij}^x$  Backward DIF: $F_{ij}^y$

$i$ means image of person No. $i$ of view A and $j$ means image of person No. $j$ of view B

- Feature Fusion: Project Backward DIF with a vector $P$ to the space of Forward DIF and merge them into a new feature.

- The ranking objectives: Learning the projection $P$ and a linear weight vector $\omega$ to make the best ranking of training data.

- Ranking objective function:

$$f(((F_{i,i}^x, P^T F_{i,i}^y)) > f(((F_{i,j}^x, P^T F_{i,j}^y)), i \neq j.$$

$$(w^*, P^*) = \min_{(w, P)} ||(w^x, P w^y)||^2 + C \sum \xi_{ij}$$

$$s.t. f(((F_{i,i}^x, P^T F_{i,i}^y)) > f(((F_{i,j}^x, P^T F_{i,j}^y)) + 1 - \xi_{ij}.$$
• Datasets

<table>
<thead>
<tr>
<th>Dataset</th>
<th># views</th>
<th># persons</th>
<th># images</th>
<th>Image size</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIPeR</td>
<td>2</td>
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<td>1264</td>
<td>128 × 48</td>
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<tr>
<td>CAMPUS</td>
<td>2</td>
<td>971</td>
<td>3884</td>
<td>160 × 60</td>
</tr>
</tbody>
</table>

• Basic Feature

Densely sampled (with the size of 10 × 10 and an overlap of 6 × 6) dColorSIFT
• Results

*DSVR_SA: Our ranking method with a single forward DIF.
*DSVR_FA: Our ranking method with the fused feature.
Experiment

• Results

*DSVR_SA: Our ranking method with a single forward DIF.
*DSVR_FA: Our ranking method with the fused feature.
Summary

• A novel ranking method which fuses the dense invariant features has been presented in this paper to model the relationship between an image pair across different camera views to solve the challenging REID problem effectively.

• The designed DIF is a good descriptor of an image pair with a large improvement on ranking performance.

• The fusion of bidirectional DIFs in the ranking process further improves the performance due to the reduction of the noise.
Future Work

- Test other feature fusion method with the SVR. alg.
- Try to apply our method to cross-modal person re-identification problem.
Thank-You.