



Local Orientation Binary Pattern with Use for Palmprint Recognition

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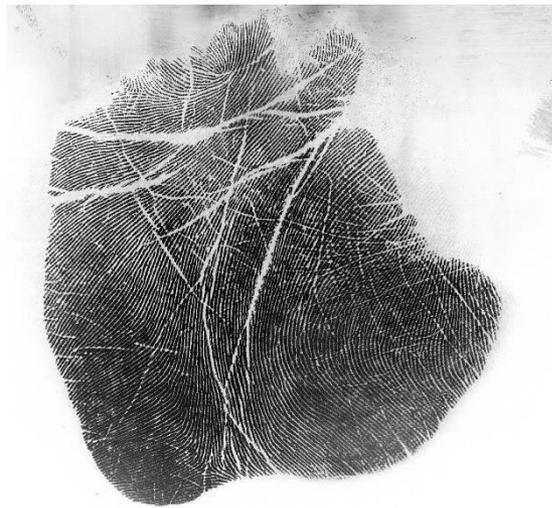
4. Conclusion

1. Introduction

✦ 1.1 Palmprint

Palmprint: refers the inner surface of a palm, which contains many features, including the principal lines, wrinkles, textures, ridge pattern and minutiae points.

- Low-resolution palmprint: civilian applications;
- High-resolution palmprint: forensic application;



1. Introduction

✦ 1.2 Palmprint recognition

Palmprint recognition: refers to the automatic personal recognition of individuals based on the palmprint based features.

- Reliable performance;
- High user-friendliness;
- Easy self-positioning;
- Non-invasive.

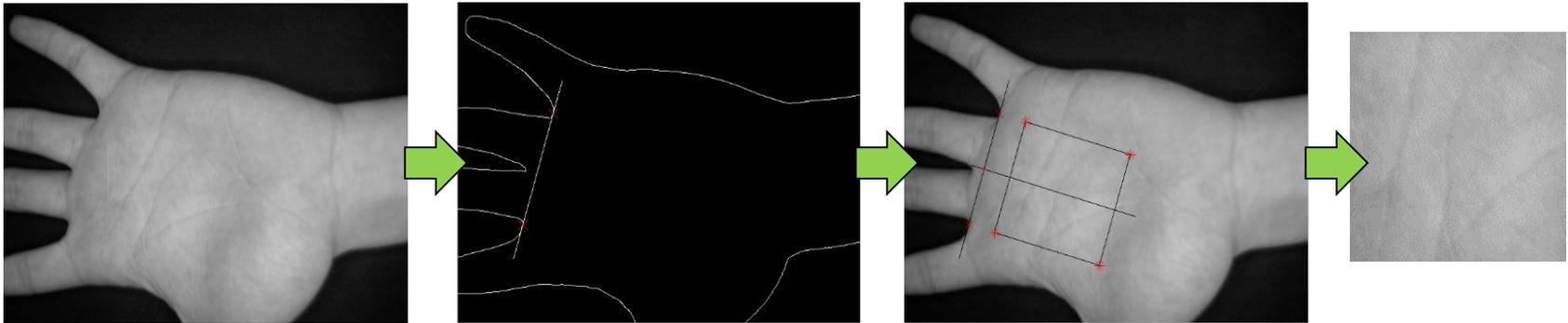


1. Introduction

✦ 1.3 Palmprint recognition procedures

Palmprint recognition procedure:

- Region of Interest (ROI) extraction;
- Features extraction;
- Matching/recognition;
- Experiments/Evaluation;



1. Introduction

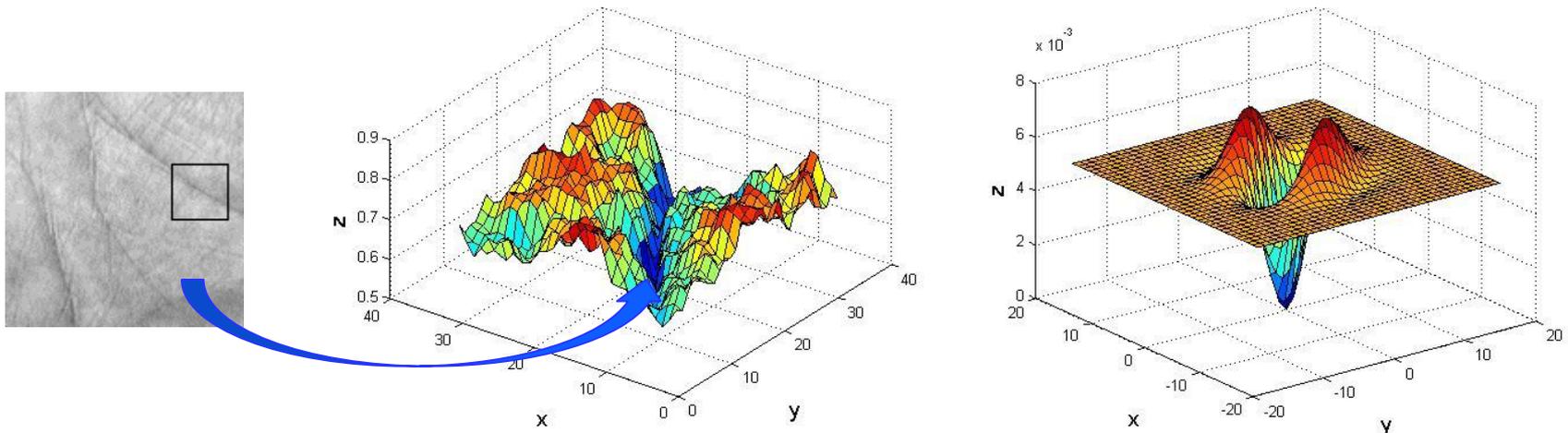
✦ 1.4 The orientation feature palmprint

The orientation features:

- The most significant and discriminative features of palmprint;

The orientation feature extraction:

- Predefine a bank of templates with multiple orientations;
- Winner-take-all rule: the orientation of the template producing the maximum convolved result is taken as the orientation of palmprint.



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2. Local orientation binary pattern

⊕ 2.1 The principal orientation and orientation confidence

The Gabor based templates:

$$G = \frac{1}{2\pi\sigma\beta} \exp\left[-\pi\left(\frac{x^2}{\sigma^2} + \frac{y^2}{\beta^2}\right)\right] \exp(2\pi\mu i(x \cos \theta + y \sin \theta))$$

$$\theta_j = (j-1)\pi / 6, (j = 1, 2, \dots, 6)$$

The principal orientation (PO):

$$res_j(x, y) = G_j^r \otimes I(x, y)$$

$$o(x, y) = \arg \max_j res_j(x, y)$$

The orientation confidence (OC):

$$c_o(x, y) = c_{o(x, y)}(x, y) = \arg \max_c res_j(x, y)$$

2. Local orientation binary pattern

⊕ 2.2 OBP

PO:

- generally represent the most dominant direction feature of palmprint;

Orientation binary pattern (OBP):

- The principal orientation feature of a center point is compared with the neighbor sets to obtain the OBP:

$$OBP = \sum_{i=1}^8 e(o_i, o_c) 2^i$$

$$e(u, v) = \begin{cases} 1 & \text{if } u = v \\ 0 & \text{otherwise} \end{cases}$$

- OBP effectively reflects the principal orientation consistency within a local patch.

2. Local orientation binary pattern

✦ 2.3 CBP

OC:

- OC generally depict the energy and stability of the principal orientation of palmprint;

Confidence binary pattern (CBP):

- The orientation confidence is binarized by thresholding within the local region to obtain CBP:

$$CBP = \sum_{i=1}^8 s(c_{o,i} - c_{o,c}) 2^i$$

$$s(u) = \begin{cases} 1 & \text{if } u > 0 \\ 0 & \text{otherwise} \end{cases}$$

- CBP generally captures the orientation confidence change information within a local patch of palmprint.

2. Local orientation binary pattern

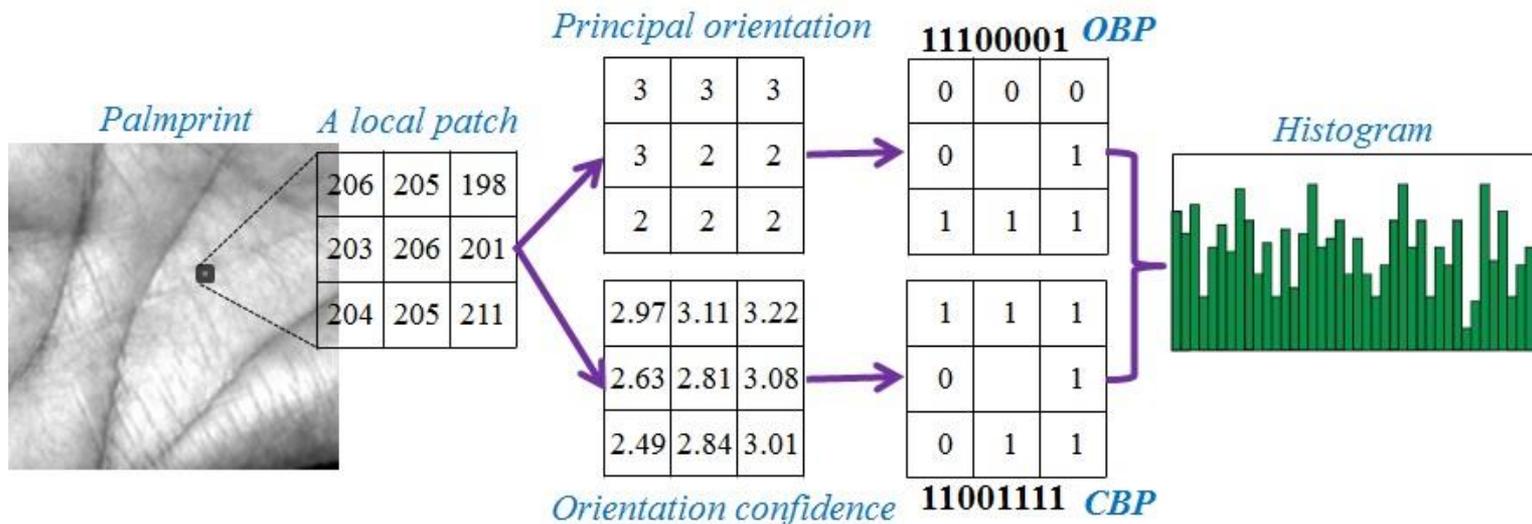
2.4 LOBP

Motivation:

- OBP and CBP are highly correlated;

Local orientation binary pattern (LOBP):

- To overcome the misalignment of palmprint, the block-wise statistics of OBP and CBP are combined to form the LOBP, and the Chi-square distance is calculated in the matching stage.



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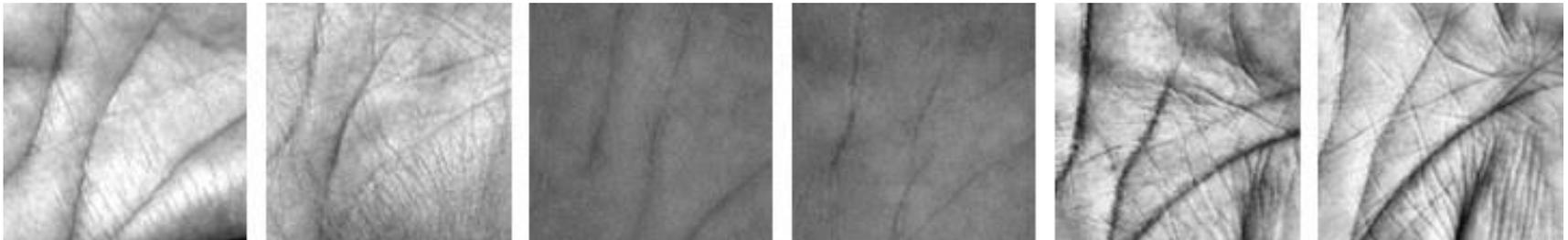
3.1 Palmprint databases

Two contact-based palmprint databases:

- PolyU palmprint database: 7752 palmprint samples from 386 different palms;
- Multiple spectral palmprint databases: 6000 palmprint samples from 500 different palms. The Green spectral palmprint sub-database is employed.

One contactless palmprint database:

- IITD palmprint database: 2601 contactless palmprint samples from 460 different palms.



(PolyU database)

(Green spectral database)

(IITD database)

3. Experiments

✦ 3.2 Palmprint verification (1)

Palmprint verification:

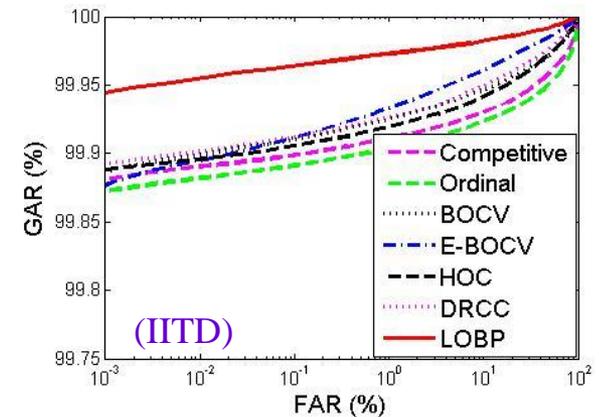
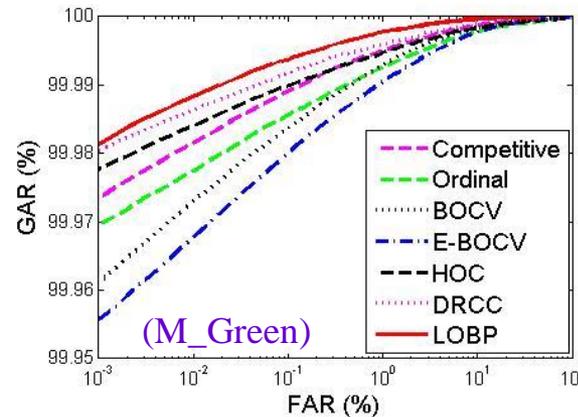
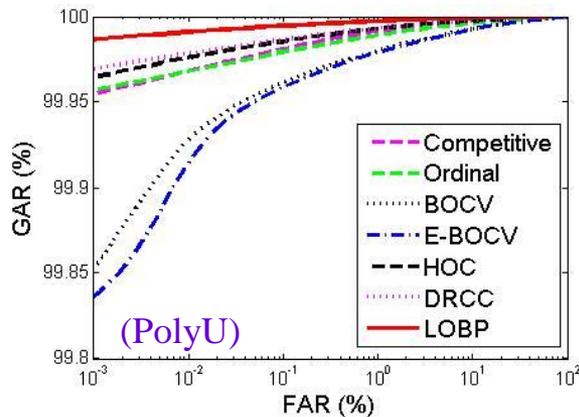
- Palmprint verification: the procedure of one-to-one palmprint;
- A genuine match: palmprint images are from the same palm;
- An impostor match: palmprint images are from two different palms;
- ROC: False acceptance rate (FAR) vs Genuine acceptance rate (GAR);
- EER: the point that FAR equals to False rejection rate (FRR).

3. Experiments

3.2 Palmprint verification (2)

Experimental results :

- State-of-the-art methods are implemented to compared with the LOBP, including the competitive code, ordinal code, BOCV, E-BOCV, HOC and DRCC methods.



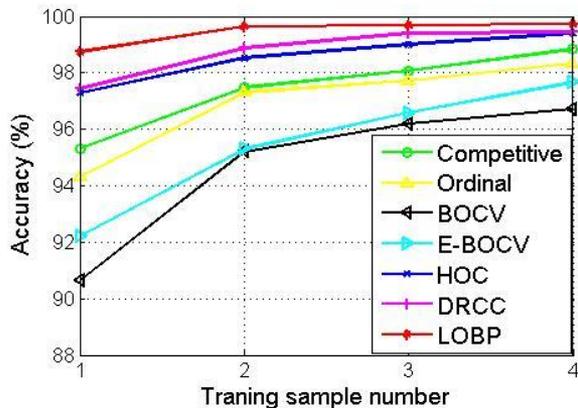
	Competitive	Ordinal	BOCV	E-BOCV	HOC	DRCC	LOBP
PolyU	0.0261	0.0272	0.0469	0.0532	0.0204	0.0189	0.0092
M_Green	0.0168	0.0202	0.0232	0.0303	0.0147	0.0122	0.0114
IITD	0.1014	0.1086	0.0908	0.0892	0.0943	0.0879	0.0394

3. Experiments

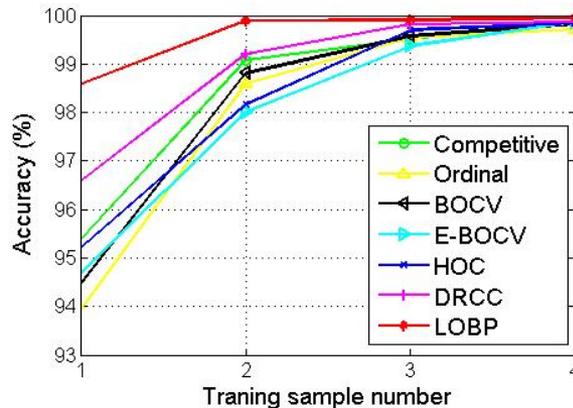
3.3 Palmprint identification

Palmprint identification:

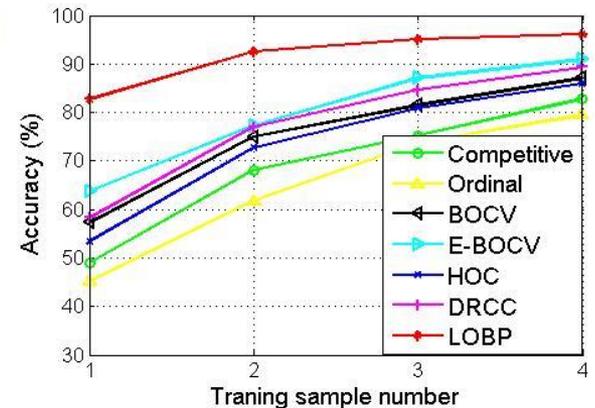
- The process of one-against-many palmprint matching;
- Find the class label of a query sample based on the training sample set;
- Randomly select n ($n=1,2,3,4$) palmprint images per palm as the training samples and used the rest as the test samples;
- Calculate the average rank-1 identification accuracy.



(PolyU)



(M_Green)



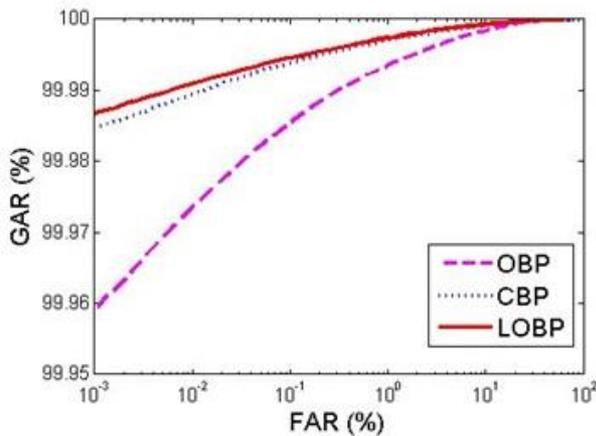
(IITD)

3. Experiments

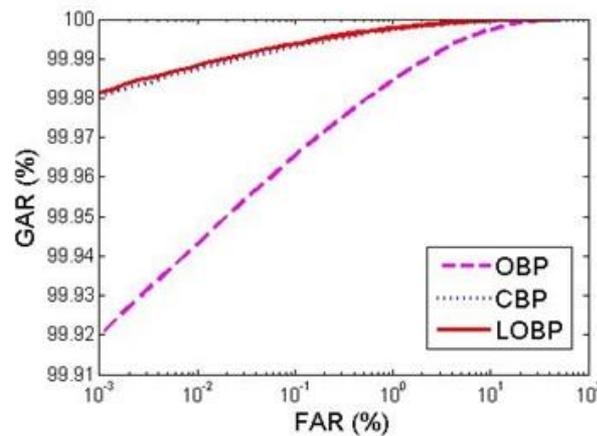
3.4 Comparison between OBP and CBP

OBP vs CBP:

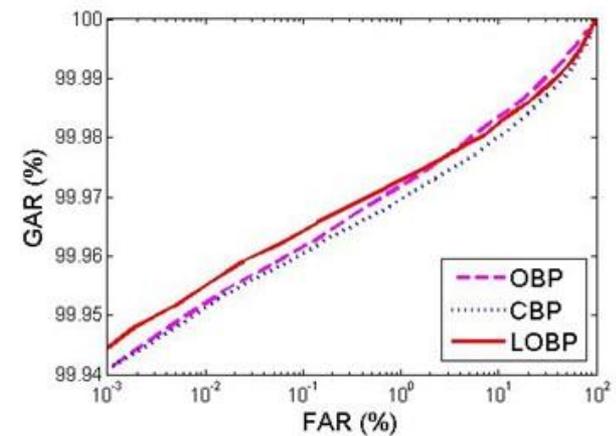
- To conduct palmprint verification based on OBP and CBP based descriptors, respectively;
- CBP performs better than OBP on PolyU and M_Green databases, and OBP achieve lower EER than CBP on IITD database;
- LOBP performs better than both CBP and OBP.



(PolyU)



(M_Green)



(IITD)

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✦ Conclusion

- The starting point of this paper is to propose an effective BP based method for palmprint recognition based on the characteristics of palmprint;
- OBP: generally captures the consistency of the dominant orientation feature within a local patch;
- CBP: effectively depicts the local changes of orientation energy;
- LOBP: a simple and effective BP based method for palmprint representation and recognition;
- Extended the LOBP to more challenging works, such as face and texture based image representation and recognition, in next future.



Many thanks!