Analysis of Face Recognition Algorithms for Blurred and Partially Occluded Images

Kaushal Patel | kaushalp@andrew.cmu.edu
Keshav Seshadri | kshadr@andrew.cmu.edu
Divya Tyamagundlu | dtyamagu@andrew.cmu.edu
Overview

- Motivation
- Database
- Face Recognition Techniques
- Results
- Conclusions
Motivation

- Face recognition - widely used in security applications
- Images may lack clarity
- Imperfections
  - Blurs due to lack of focus or motion of the subject
  - Partial occlusion due to glasses or partial face capture
- Performance of various face recognition techniques in such scenarios without pre-processing.
Database

- Pose Illumination and Expression (PIE*) Database (with illumination)
  - 65 people x 22 images
  - Image Size: 100x100 pixels
- Training Set: Image # 2,3,7,8,16,17
- Testing Set: All other 16 images modified with blurs and partial-occlusion

* http://www.ri.cmu.edu/projects/project_418.html - PIE
Partially Occluded Images

Original Image

25% Horizontal Strip Blocked

25% Vertical Strip Blocked
Blurred Images

Original Image

Disk Blur

Motion Blur
Techniques

- **PCA**
  - 65x6 = 390 training images
  - 389 eigen faces
  - Dimensionality reduction from 10,000 to 389

- **LDA**
  - 390 training images, 65 classes
  - 65-1 = 64 length feature vectors
  - Dimensionality reduction from 10,000 to 64
Techniques

- **MACE***
  - 65 filters
  - Test images correlated with each filter
  - PSR determined

\[ PSR = \frac{\text{Peak} - \text{Mean}}{\sigma} \]

- Effective dimensionality reduction from 10,000 to 65

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Techniques

- MACE

Sample outputs for an occluded image
Techniques

- SVMs
  - Mapping onto higher dimensional space
  - Used to boost PCA/LDA performance
  - Tool used: MATLAB Arsenal* implementing libSVM
  - Radial Basis Function Kernel
    \[ \exp(-\gamma (u-v)^2) \]
    with a parameter of 0.13 to perform a one-against-all scheme for multi-class classification
Results: Disk Blur

Original Image

Disk Blur 7

Disk Blur 4
Results: Motion Blur

Original Image

Motion Blur 6

Motion Blur 10
Results: Horizontal Occlusion
Results: Vertical Occlusion

Original Image

![Graph showing results](image-url)
## Results: PCA

<table>
<thead>
<tr>
<th>Image Type</th>
<th>Rank1 ID %</th>
<th>EER %</th>
<th>Verif\textsuperscript{th} Rate @ FAR = 0.1%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original</td>
<td>33.2</td>
<td>45.9</td>
<td>4.57</td>
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<tr>
<td>Disk Blur 4</td>
<td>31.1</td>
<td>46.2</td>
<td>3.13</td>
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<td>Disk Blur 7</td>
<td>32.1</td>
<td>46.2</td>
<td>2.92</td>
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<tr>
<td>Motion Blur 6</td>
<td>32.1</td>
<td>46.2</td>
<td>2.83</td>
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<tr>
<td>Motion Blur 10</td>
<td>31.5</td>
<td>46.1</td>
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<tr>
<td>HM 1</td>
<td>5.87</td>
<td>47.2</td>
<td>0.79</td>
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<td>HM 2</td>
<td>3.17</td>
<td>46.9</td>
<td>0.5</td>
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<tr>
<td>VM 1</td>
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<td>47.1</td>
<td>2.82</td>
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<td>VM 2</td>
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## Results: LDA

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<td>Motion Blur 10</td>
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<tr>
<td>HM 1</td>
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<td>1.46</td>
<td>98.0</td>
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<tr>
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<td>VM 1</td>
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<td>1.00</td>
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<tr>
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## Results: MACE

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<td>HM 2</td>
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<td>100</td>
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<tr>
<td>VM 1</td>
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<td>1.00</td>
<td>100</td>
</tr>
<tr>
<td>VM 2</td>
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<td>1.00</td>
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Conclusions

- PCA performs under par, but PCA+SVM improves it
- LDA is resilient, while LDA+SVM is not a big improvement
- MACE performs well with occluded, but fails with blurred images
Thank You