Automatic Eye Detection Error as a Predictor of Face Recognition Performance

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Verification Experiment

Verification Decision Uncertainty in Decision

- front pose and illum.
- uneven illumination
- non-frontal pose
## Verification Experiment

<table>
<thead>
<tr>
<th>Verification Decision</th>
<th>Uncertainty in Decision</th>
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</thead>
<tbody>
<tr>
<td>YES</td>
<td>least uncertain</td>
</tr>
<tr>
<td>YES</td>
<td>more uncertain</td>
</tr>
<tr>
<td>YES</td>
<td>most uncertain</td>
</tr>
</tbody>
</table>

- **Frontal pose and illum.**
- **Uneven illumination**
- **Non-frontal pose**
Predictor of Face Recognition Performance

- many existing predictors: pose, illumination, noise, blur, etc.
- we propose a novel predictor: Automatic Eye Detection Error (AEDE)
Automatic Eye Detection Error (AEDE)

- $p^m_{\{l,r\}}$ manually annotated eye locations
- $p^d_{\{l,r\}}$ automatically detected eye locations

$$J = \frac{\max\{||p^m_l - p^d_l||, ||p^m_r - p^d_r||\}}{||p^m_l - p^m_r||}$$
Does AEDE respond to image quality variations?

We visually inspect the distribution of AEDE (J) for different pose and illumination variations.

Figure: MultiPIE camera and flash positions.
Does AEDE respond to image quality variations? ...

**Figure:** Distribution of normalized eye detection error $J$ of probe images for illumination variations.
Does AEDE respond to image quality variations? ...
Does AEDE respond to image quality variations? ...
Relation between AEDE and Recognition Performance

- MultiPIE dataset and FaceVACS (use for eye detection and recognition)
- Gallery: fixed to high quality frontal mugshot
- Probe: pose and illumination variations
- We plot Receiver Operating Characteristics (ROC) curve corresponding to four intervals of $J_p$
Relation between AEDE and Recognition Performance …

Figure: Recognition performance variation for each monotonically increasing interval of normalized eye detection error $J$. 
Conclusions

- monotonically increasing intervals of AEDE correspond to distinct recognition performance. Therefore, AEDE is a predictor of face recognition performance.
- AEDE can be seen as a summary of many other image quality parameters like pose, illumination etc.
- AEDE has a non-linear relationship with face recognition performance and further work is required to fully understand the reasons for this non-linearity.
Limitations

- AEDE requires manually annotated eye coordinates in order to quantify the quality of a facial image.
- AEDE cannot capture all types of quality variations that may affect face recognition performance. For example, in a photograph containing facial image with closed eye, the eye detection error will be very high. This does not necessarily translate into a difficult verification problem. Therefore, we need more quality parameters to fully quantify the variability in recognition performance.
Questions?