Introduction I

What is longitudinal finger rotation?
- misplacement of the finger during acquisition

The Problem of longitudinal finger rotation:
- causes a deformation of the vein pattern
- negatively affects recognition performance

The Problem for finger vein recognition:
- detection and correction is a difficult task
- state-of-the-art single camera recognition systems can handle it only to a certain extent

Our Solution:
- A CNN based rotation detector that allows to align images ahead of biometric comparison
CNN Based Rotation Detection

CNN Training

Images of the same finger but with different rotations (0° and 45°)

2-channel input image

ResNext CNN

rotation prediction

actual rotation

MSE loss

Figure: Scheme of CNN training for rotation estimation

B. Prommegger, C. Kauba, A. Uhl: Longitudinal Finger Rotation in Public Finger Vein Data Sets
Data Sets

- Protect Multimodal Database (PMMDB, [2]) for training
- PLUSVein Finger Rotation Data Set (PLUSVein-FR, [3]) for evaluation
- Provide finger vein samples all around the finger in steps of 1°
- Rotational difference between two samples is known
Experiments

- CNN Training was executed on different rotational ranges $\Theta$

- Best results for $\Theta = \pm 45^\circ$
- Stable results up to at least $\pm 30^\circ$
Result Verification / Generalisability of Proposed CNN

- 4 publicly available finger vein data sets
- Evaluate change of the recognition performance after applying rotation correction using our rotation prediction $\hat{\phi}$
- Data sets contain different amount of longitudinal finger rotation
- Align images ahead of evaluation
- **CNN was not retrained for evaluated data sets!**
Table: Recognition performance (EER) and relative performance increase (RPI)

<table>
<thead>
<tr>
<th>Data Set</th>
<th>Method</th>
<th>EER [%]</th>
<th>RPI [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDUMLA-HMT [4]</td>
<td>original aligned</td>
<td>4.73</td>
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<td></td>
<td>aligned</td>
<td>1.30</td>
<td>263.40</td>
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<td>FV-USM [5]</td>
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<td>1.23</td>
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<td>aligned</td>
<td>0.52</td>
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<td>0.08</td>
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<tr>
<td></td>
<td>aligned</td>
<td>0.05</td>
<td>61.23</td>
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</tbody>
</table>
Conclusion

- CNN-based rotation detector to estimate longitudinal rotation between two finger vein image samples.
- Fast prediction (approximately 15ms on a GPU system)
- Stable results in the range of ±30°
- Rotation detector is not limited to a single data set (can be reused without retraining)
- Can be used in live systems (rotation detection and correction ahead of every biometric comparison)
Thank you!


