Advanced Multi-Perspective Enrolment in Finger Vein Recognition

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Abstract

Longitudinal finger rotations poses a sever problem to finger vein recognition systems. Multi perspective enrolment, which acquires vein images all around the finger during enrolment and comparing these images against a single one for recognition, is one way to tackle this problem. This work analyses further approaches to improve its recognition rates.

Multi-Perspective Enrolment

Multi-Perspective Enrolment (MPE)

- Enrolment of subjects using multiple perspectives
- Single perspective for recognition
- Invariant to rotation as enrolment covers complete (rotational) range of interest

Perspective Multiplication for MPE (PM-MPE)

- Introduction of additional pseudo-perspectives
- Reduces distance between enrolment perspectives

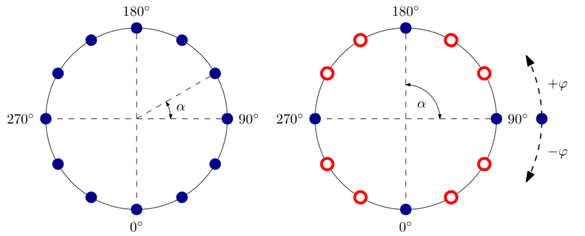

Figure 1: Camera positioning for MPE (left) and PM-MPE (right) for a rotational distance of 30° between the perspectives. The filled blue dots are cameras, the red circles represent pseudo-perspectives.

Contribution

Analysis of Different Recognition Schemes

- Maximum Curvature (MC, as in original papers)
- Wide Line Detector (WLD)
- Finger Vein Recognition with Anatomy Structure Analysis (ASAVE)
- A SIFT-based Approach (SIFT)

Perspective Shifts for (PM-)MPE

- Changing position of enrolment cameras
- Should avoid co-occurrence of negative impact factors during comparison

Additional Pseudo-Perspectives for PM-MPE

- Introduction of additional pseudo-perspectives
- Additional cameras should further decrease rotational distance.

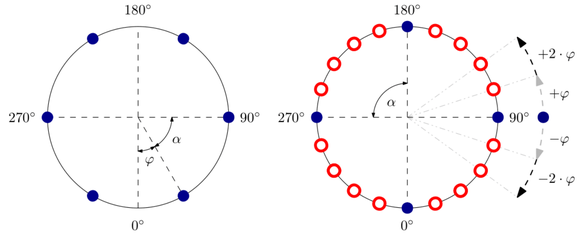

Figure 2: Camera positioning for perspective multiplication (left) and PM-MPE using additional perspectives (right). The filled blue dots are cameras, the red circles represent pseudo-perspectives.

Baseline Results

- Reference: Intra-perspective comparisons (IPP) without correction and using circular pattern normalization (CPN)
  - Best at 0° and 180°
  - Worst at 90° and 270°
- Distance between enrolment cameras is crucial for recognition accuracy
- Noticeable performance drop when distance to enrolment cameras increase
- PM-MPE outperforms MPE

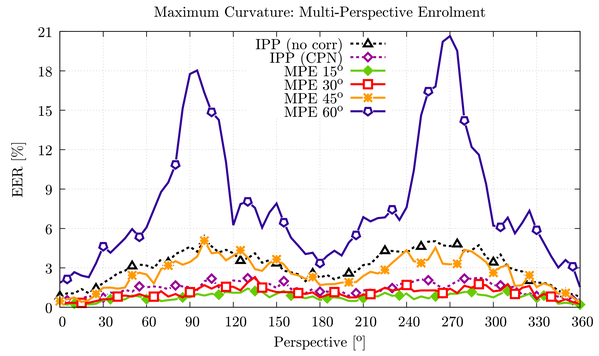

Figure 3: Baseline Results for MPE using MC features

Perspective Shifts for (PM)-MPE

Aim

- Mitigate performance drops inbetween enrolment cameras

Outcome

- A shift of the enrolment cameras results in a shift of the result curve by the same angle
- Distance to enrolment cameras is more important than the performance of the recognition perspective itself

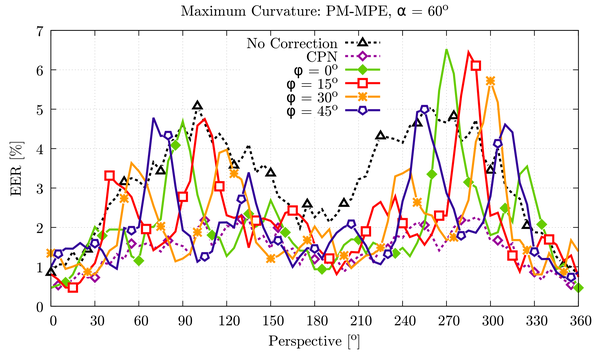

Figure 4: Results after applying perspective shifts for PM-MPE using MC features

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Recognition Schemes and Additional Pseude-Perspectives

Aim

- Evaluate applicability of (PM-)MPE to different recognition schemes
- Investigate influence of additional pseudo-perspectives

Outcome

- Simple vein pattern based systems (MC, WLD) benefit most from (PM-)MPE
- SIFT is suitable to be used together with (PM-)MPE
- Performance increase for PM2-MPE and PM3-MPE does not justify additional computational complexity/cost

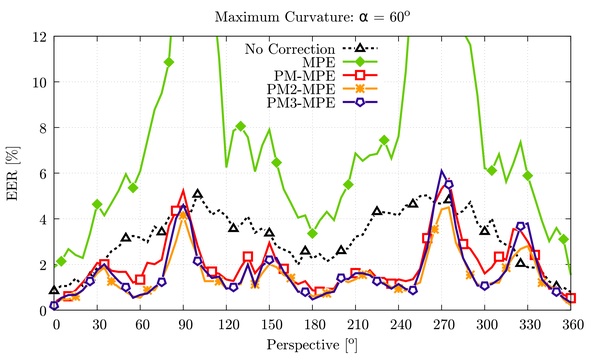

Figure 5: Performance Results for MC ($\varphi = 60°$)

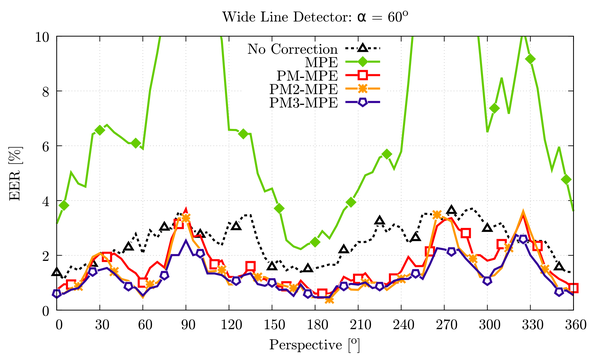

Figure 6: Performance Results for WLD ($\varphi = 60°$)

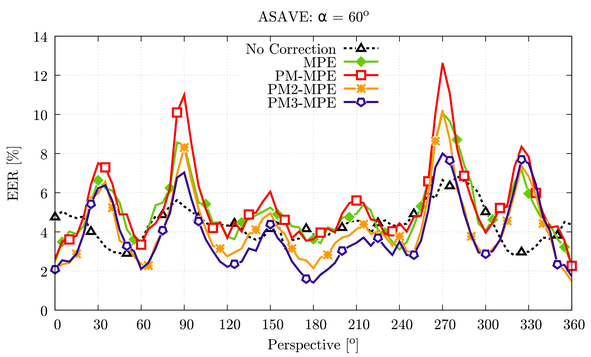

Figure 7: Performance Results for ASAVE ($\varphi = 60°$)

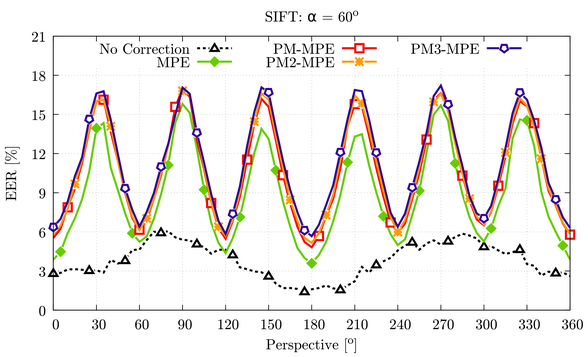

Figure 8: Performance Results for SIFT ($\varphi = 60°$)