Rotation Detection in Finger Vein Biometrics using CNNs

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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 effects 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 Training

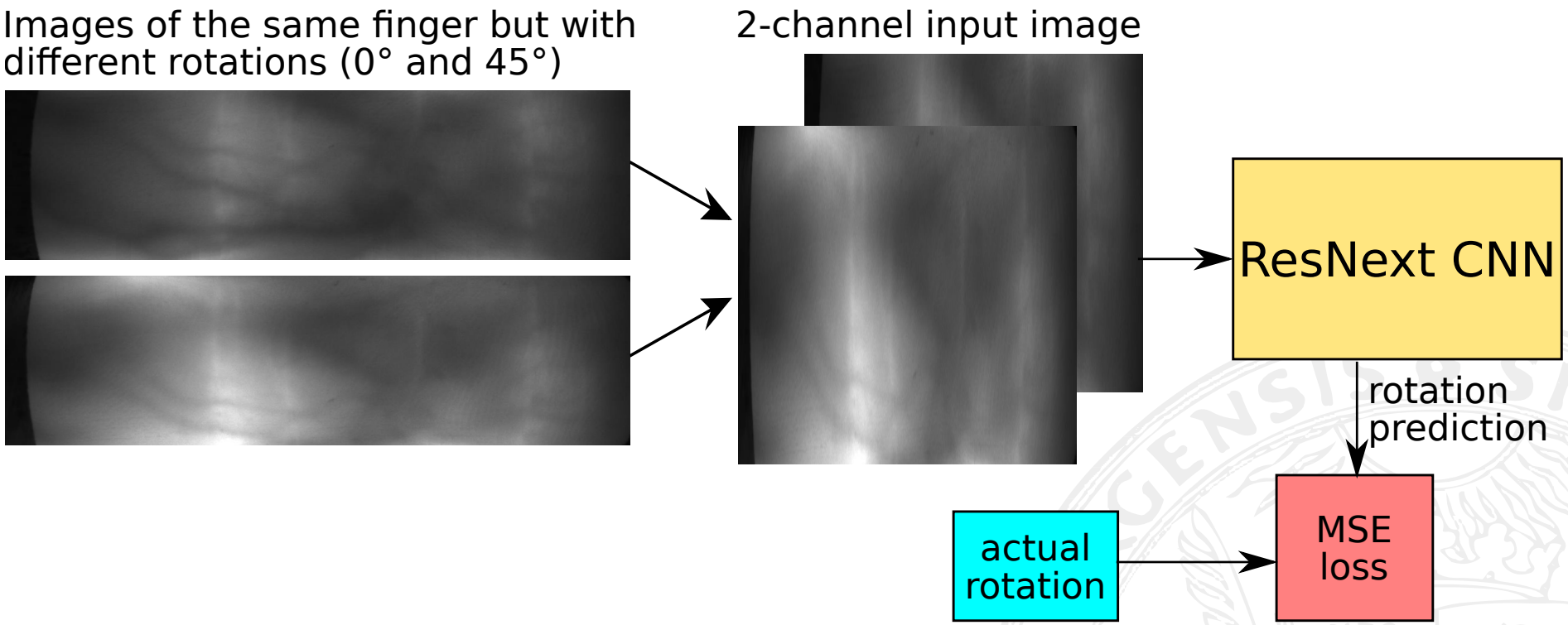


Figure: Scheme of CNN training for rotation estimation

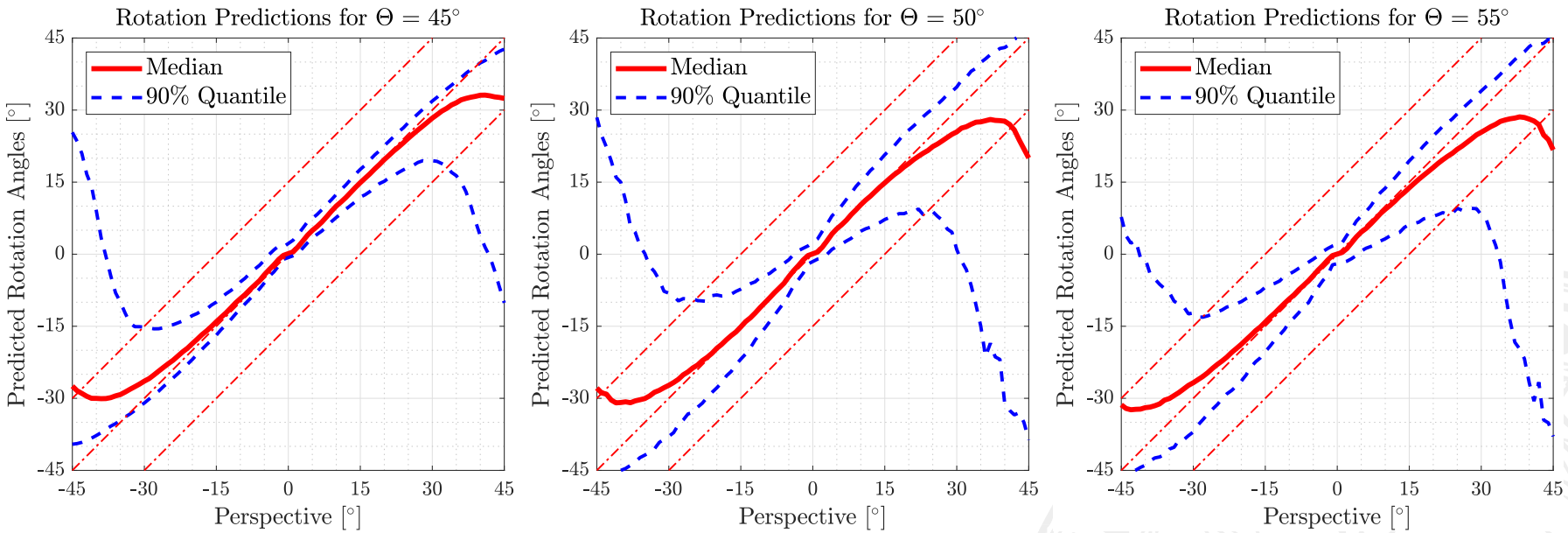
CNN Based Rotation Detection II

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 Θ



- Best results for $\Theta = \pm 45°$
- Stable results up to at least $\pm 30°$

CNN Based Rotation Detection IV

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 $\hat{\varphi}$
- Data sets contain different amount of longitudinal finger rotation
- Align images ahead of evaluation
- **CNN was not retrained for evaluated data sets!**

CNN Based Rotation Detection V

Table: Recognition performance (EER) and relative performance increase (RPI)

Data Set	Method	EER [%]	RPI [%]
SDUMLA-HMT [4]	original aligned	4.73 1.30	- 263.40
FV-USM [5]	original aligned	1.23 0.52	- 137.03
UTFVP [6]	original aligned	0.42 0.18	- 125.47
PLUSVein-FV3 [7]	original aligned	0.08 0.05	- 61.23

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 $\pm 30°$
- 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)

The End

Thank you!

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