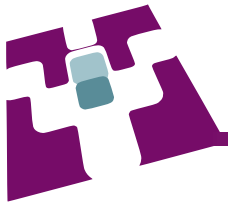
Pixel Pruning for Fingerprint Quality Assessment

Z. Yao, C. Charrier, J.-M. Le Bars and C. Rosenberger

Normandie Univ - FRANCE

Normandie Université

NIST International Biometric Performance Testing Conference 2016



Introduction

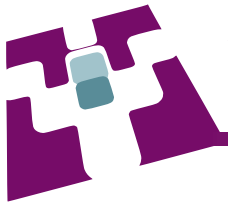
Motivations

Quality of acquired biometric data is essential :

- Optimizing the enrollment process (reference with the best quality),
- Additional information for multi-biometrics,
- Use as soft biometric information ...

Biometric data quality

- Related to the information content (data),
- Dependent of the sensor,
- User interaction correctness with the sensor.



State of the art

Quality metrics

Many contributions :
Bolle et al. 1999, Shen et al. 2001, Lim et al. 2002, Tabassi et al. 2004 (NFIQ), Lee et al. 2005, Olsen et al. 2012, Li et al. 2013, El Abed et al. 2013 (Q), Yao et al. 2015, Olsen et al. 2015, Tabassi & Grother 2015...

Contributions

- Proposal of a new Fingerprint quality assessment metric (FQA) based on pixel pruning,
- Metric validation based on the Enrollment Selection (ES) method.

Quality Metric Calculation (1/4)

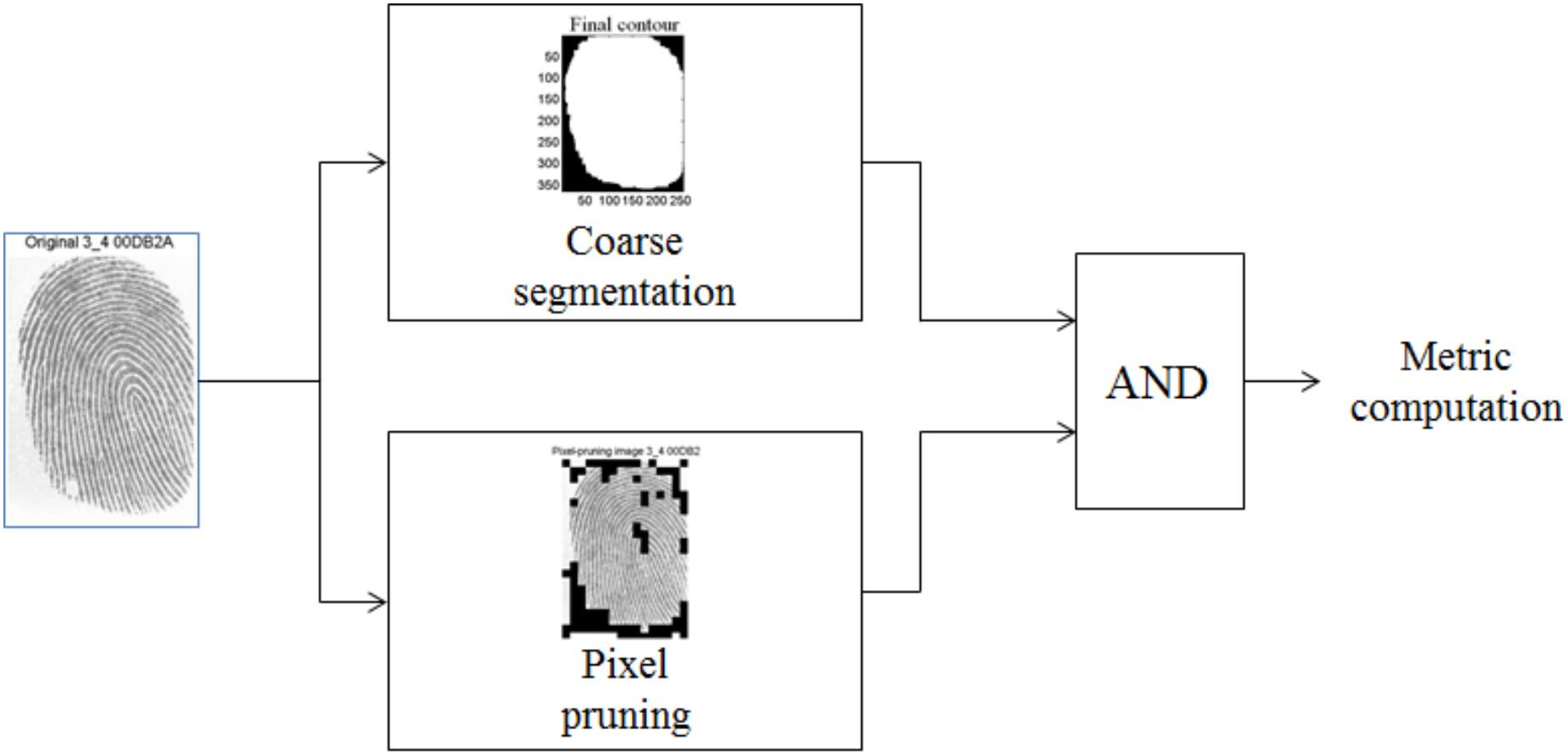


FIGURE 1: Quality metric computation

Quality Metric Calculation (2/4)

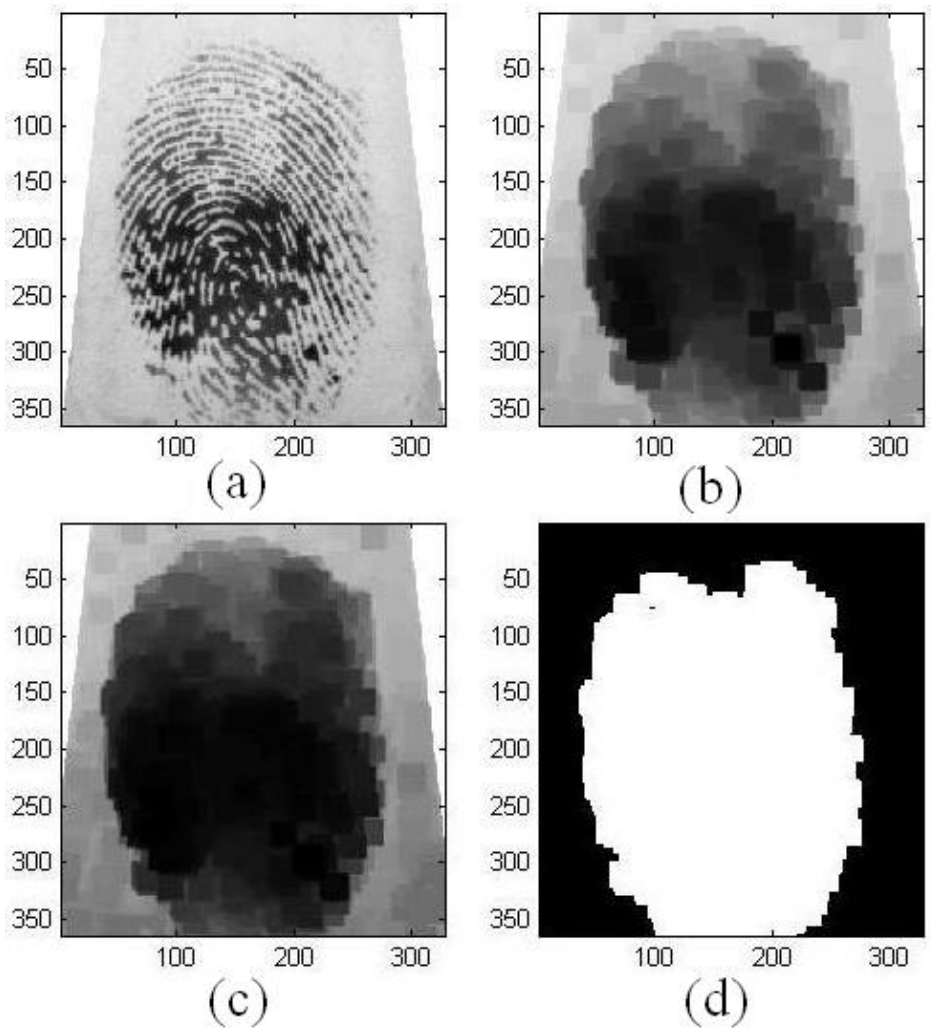


FIGURE 2: Coarse segmentation : (b) erosion, (c) contrast enhancement, (d) Otsu binarization

Quality Metric Calculation (3/4)

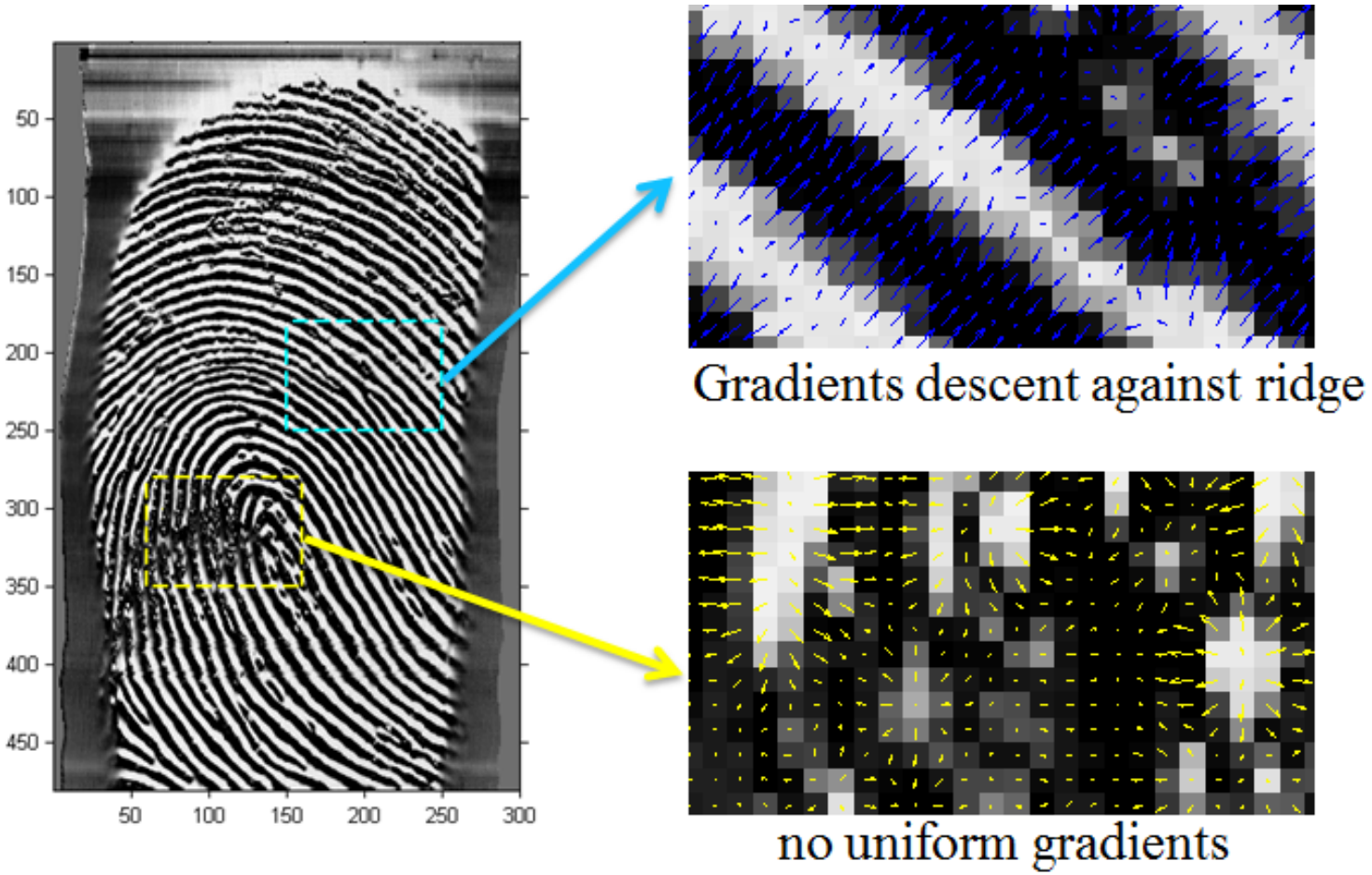


FIGURE 3: Coherence of ridges gradients

Quality Metric Calculation (4/4)

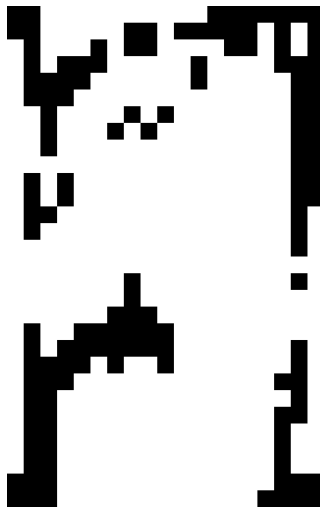
Coherence feature

Gradient measures of pixel intensity in a local window size W :

$$Coh = \frac{\sqrt{(G_{xx} - G_{yy})^2 + 4G_{xy}^2}}{G_{xx} + G_{yy}} \quad (1)$$

where $G_{xx} = \sum_W G_x^2$, $G_{yy} = \sum_W G_y^2$, $G_{xy} = \sum_W G_x G_y$ and (G_x, G_y) is the local gradient.

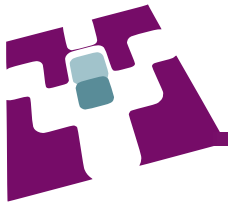




Protocol (1/2)

TABLE 1: Datasets specifications

DB	Sensor	Dim.	Resolution
00DB2A	Low-cost Capacitive	256×364	500dpi
02DB2A	Optical	296×560	569dpi
04DB1A	Optical	640×480	500dpi
04DB2A	Optical	328×364	500dpi
04DB3A	Thermal	300×480	512dpi



Protocol (2/2)

Protocol

- Minutiae templates are extracted by using MINDTCT.
- Matching scores are computed by using Bozorth3 and a commercial SDK ;
- NFIQ values of fingerprints (NBIS),
- EER computation with a confidence intervall at 95%,
- Validation of quality metrics based on the Enrollment Selection (ES) method presented at IBPC 2014.

Enrollment Selection (1/5)

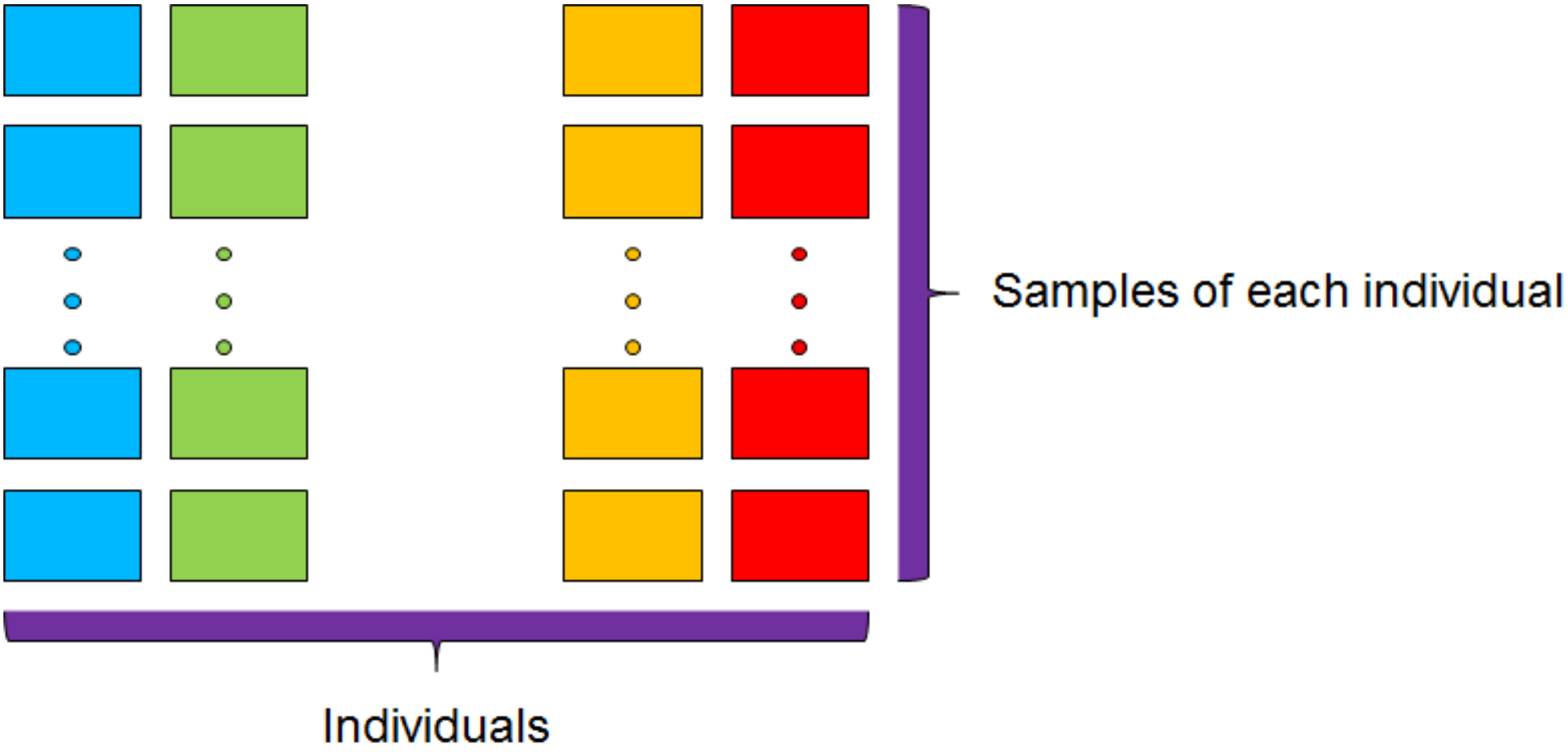


FIGURE 4: A classical biometric dataset : for FVC databases, 8 samples and 100 individuals

Enrollment Selection (2/5)

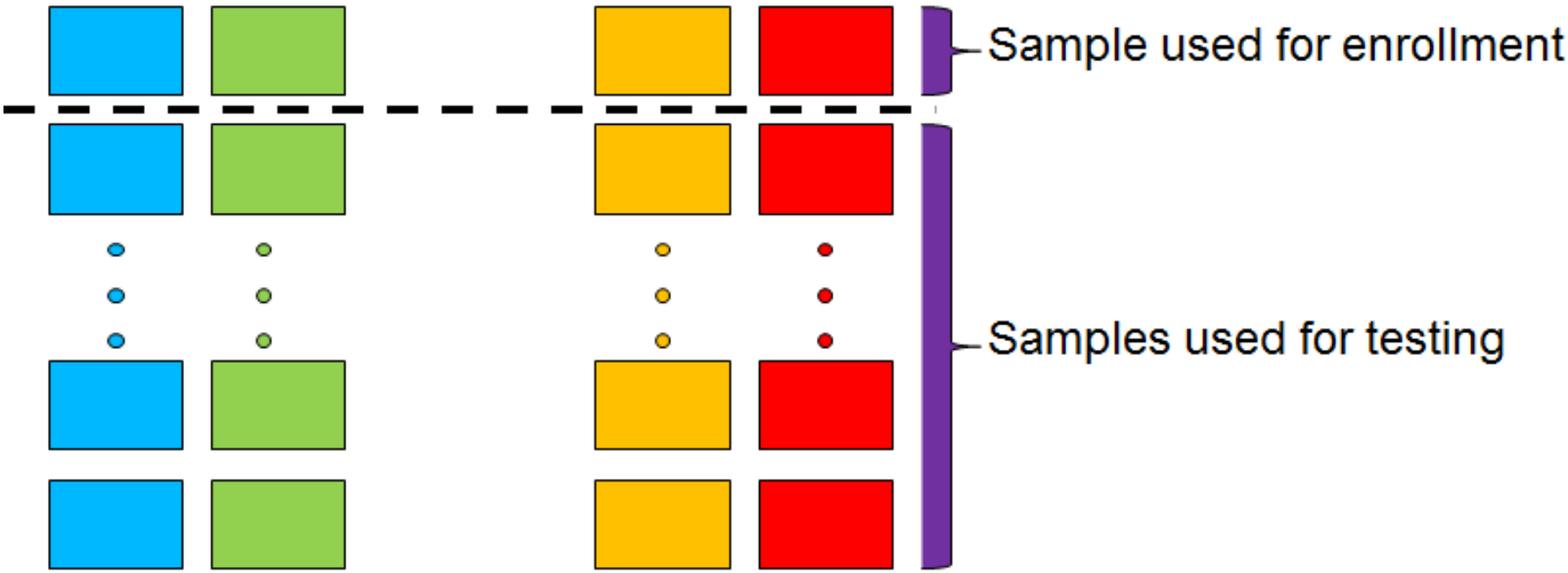


FIGURE 5: Enrollment without any quality checking

Enrollment Selection (3/5)

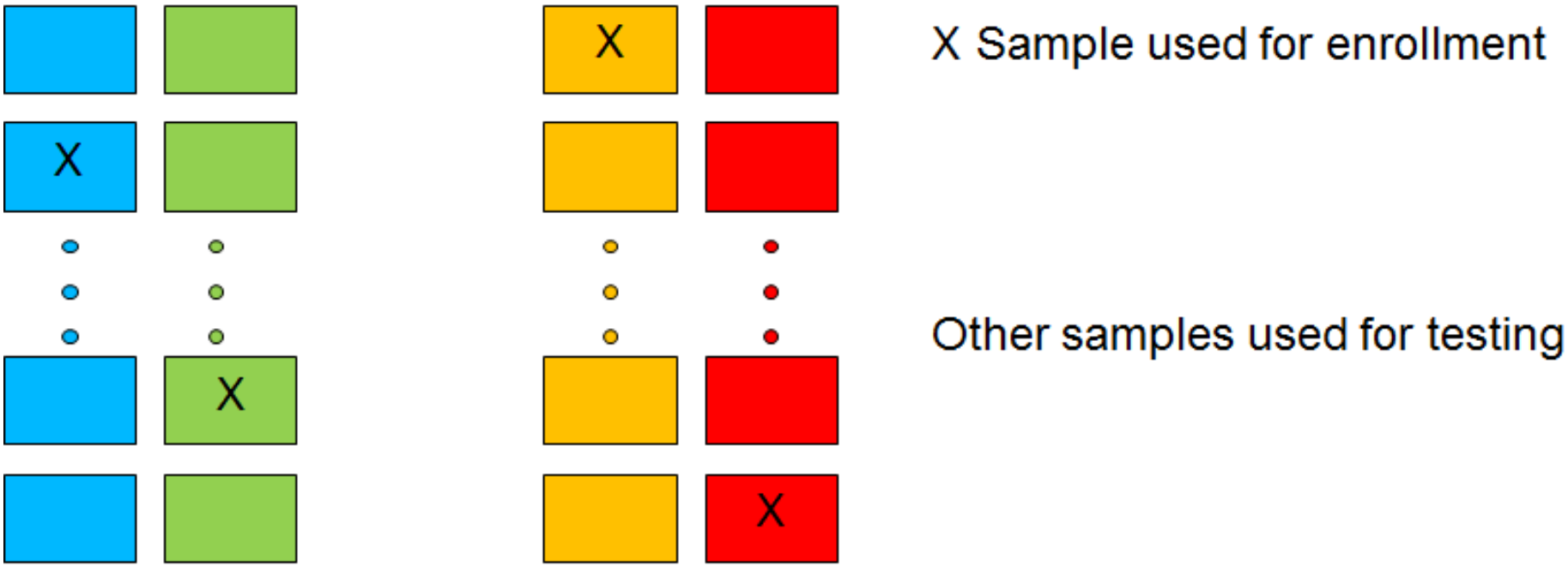
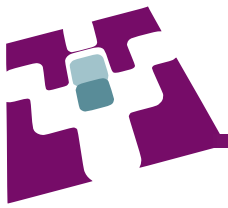


FIGURE 6: Enrollment with quality checking



Protocol (4/5)

Best and worst choices

For each user :

- Compute EER or AUC value of the system by choosing each sample as reference
- Take the sample with maximal EER or AUC value as worst choice,
- Take the sample with minimal EER or AUC value as best choice,

Quality metric

Use the quality metric to choose the reference template among user' samples

$\rightarrow$ Computation of DET curves by applying these different strategies for the choice of the reference template.

Enrollment Selection (5/5)

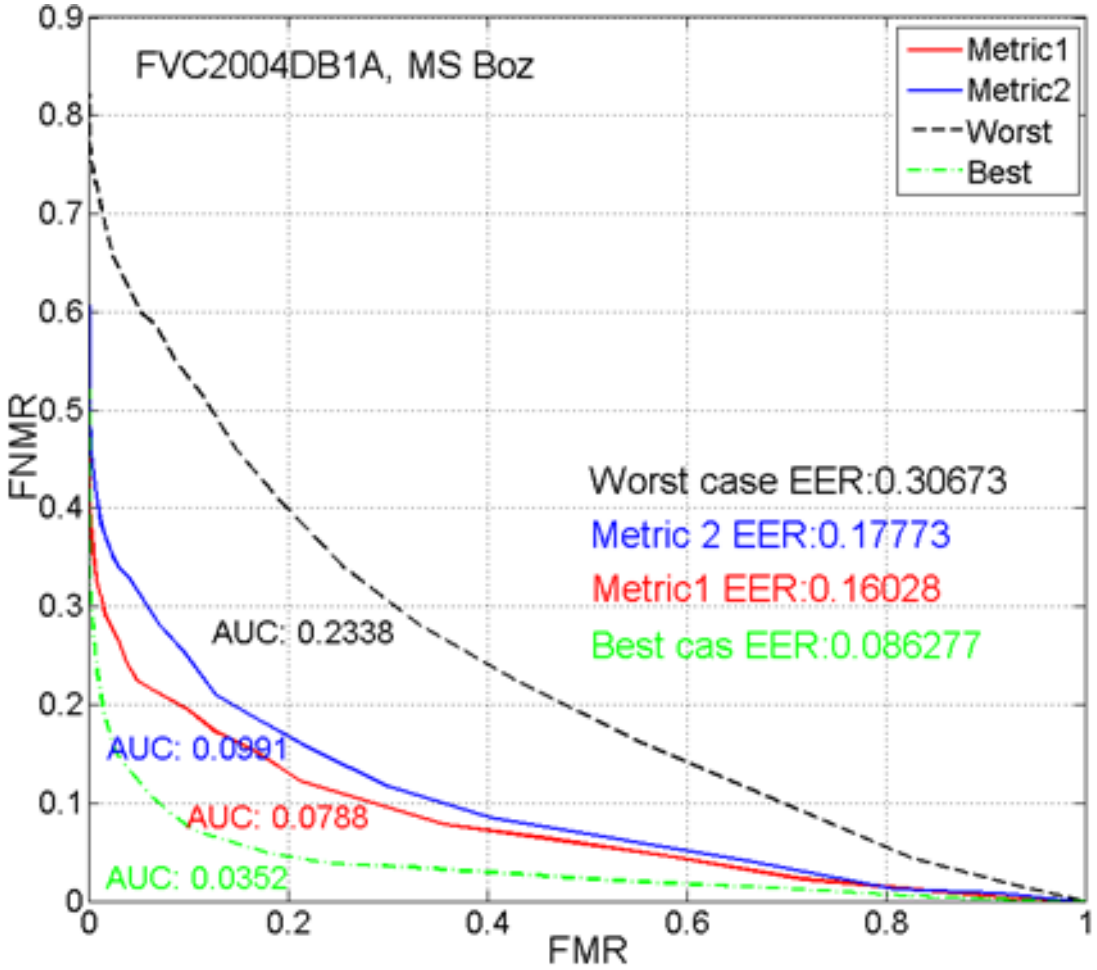
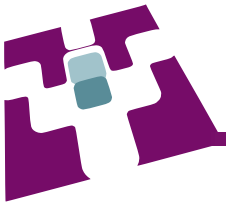


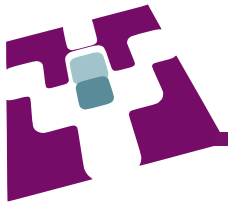
FIGURE 7: Examples of obtained DET curves



Experimental results

TABLE 2: The 95% CI of the global EER of each metric.

DB \ QM	NFIQ	Pixel pruning
00DB2A (NBIS)	[0.0490 0.0500]	**[0.0450 0.0461]**
02DB2A (NBIS)	[0.1326 0.1340]	**[0.1068 0.1084]**
04DB1A (NBIS)	**[0.1540 0.1557]**	[0.1645 0.1662]
04DB2A (NBIS)	**[0.1312 0.1334]**	[0.1396 0.1413]
04DB3A (NBIS)	[0.0745 0.0756]	**[0.0712 0.0723]**
00DB2A (SDK)	[0.0022 0.0024]	**[0.0009 0.0011]**
02DB2A (SDK)	**[0.0011 0.0013]**	[0.0019 0.0021]
04DB1A (SDK)	[0.0266 0.0275]	**[0.0189 0.0196]**
04DB2A (SDK)	[0.0384 0.0397]	**[0.0319 0.0328]**
04DB3A (SDK)	[0.0189 0.0195]	**[0.0148 0.0153]**



Conclusion & perspectives

Conclusions

- A simple pixel pruning quality metric ;
- Validation with the ES method ;
- Experiments show the dependency with the dataset and matcher.

Perspectives

Taking into account other features

- Minutiae features
- Orientation features.

Thanks for Your Attention

http://www.epaymentbiometrics.ensicaen.fr/