

Image Quality Assessment to Enhance Infrared Face Recognition

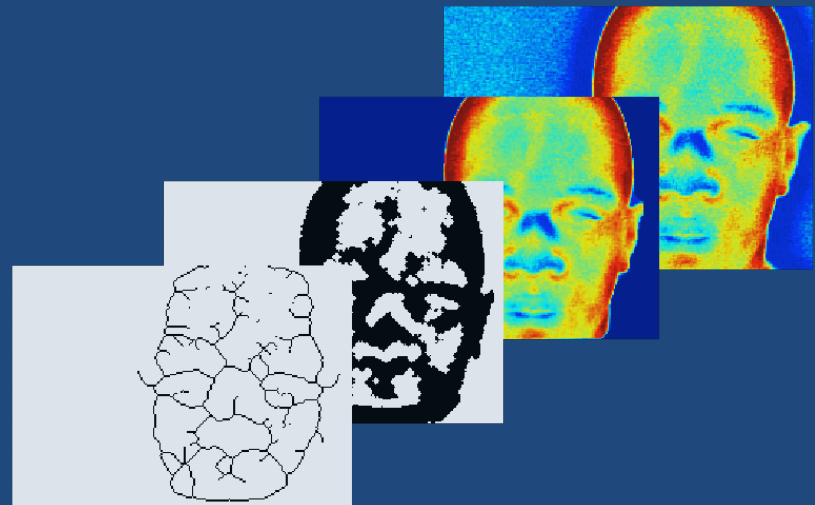
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Outline

Introduction & motivation

- Infrared (IR) face recognition
- IR image quality assessment

Methods

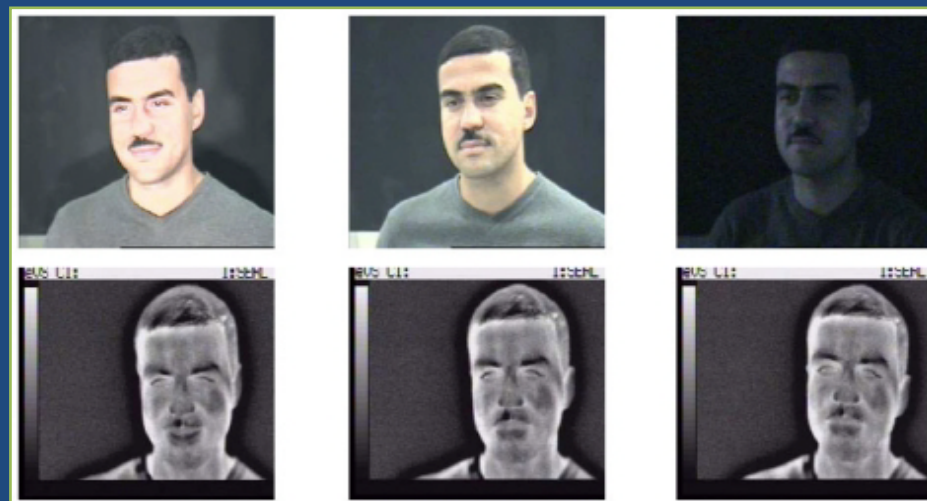
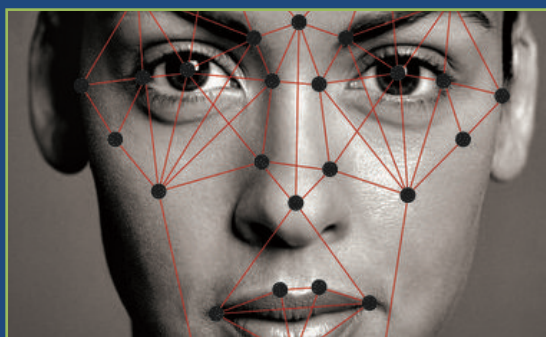
- IR facial databases and distortions
- IR face recognition based on thermal signatures
- Enhancement with quality-aware features

Results

- Without quality-aware features
- With quality-aware features

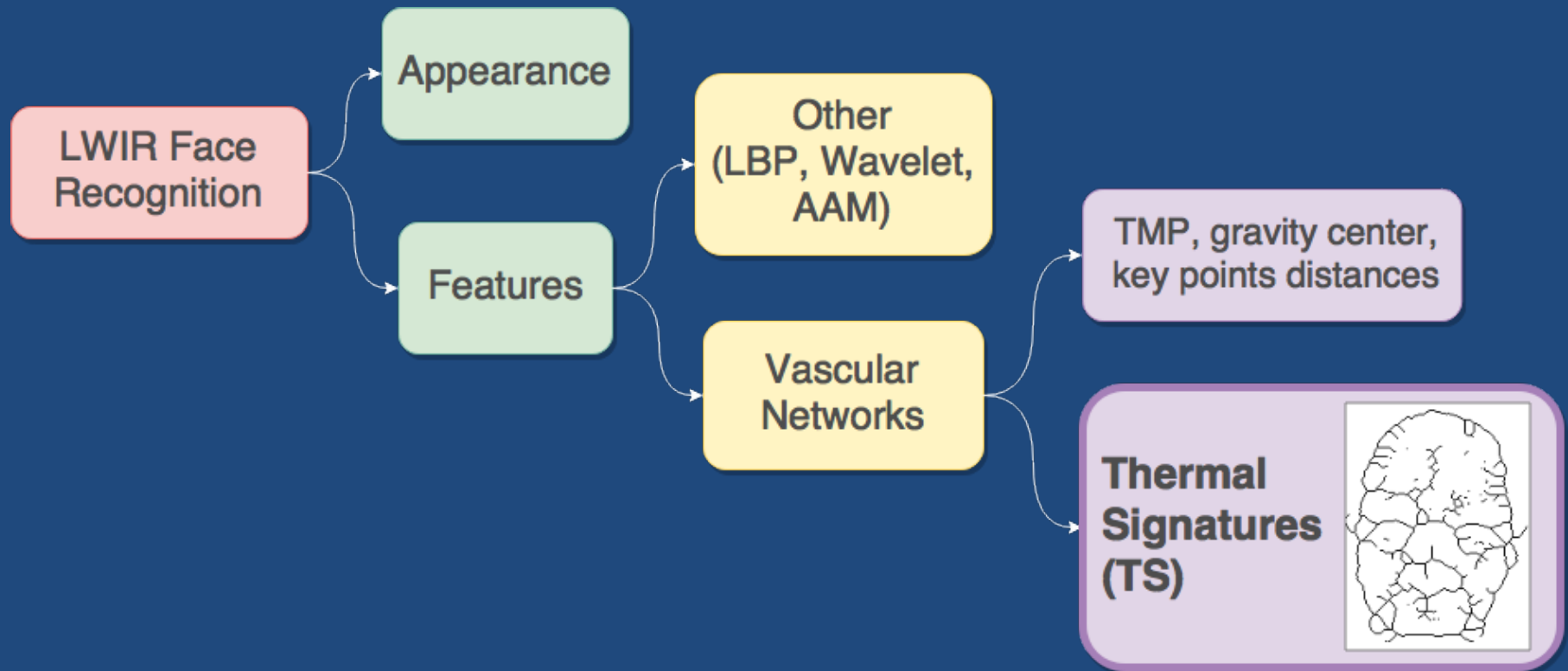
Conclusions – Future work

Infrared Face Recognition



Ghiass et al., Pattern Recognit., 2014

IR Face Recognition Methods

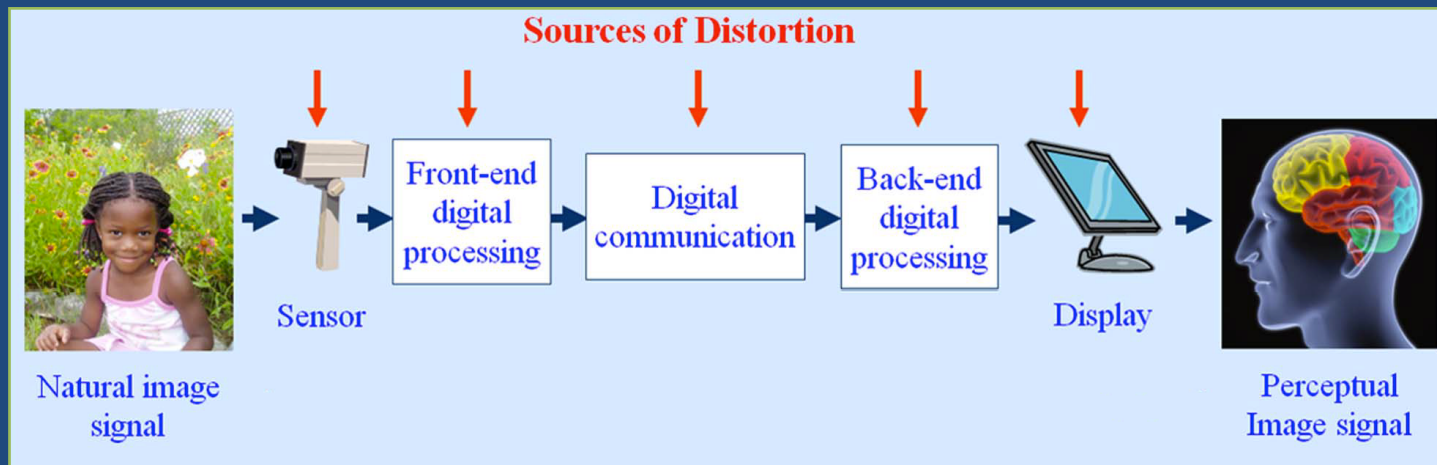
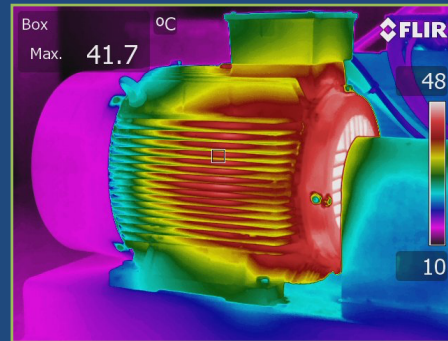


Ghiass et al., Pattern Recognit., 2014

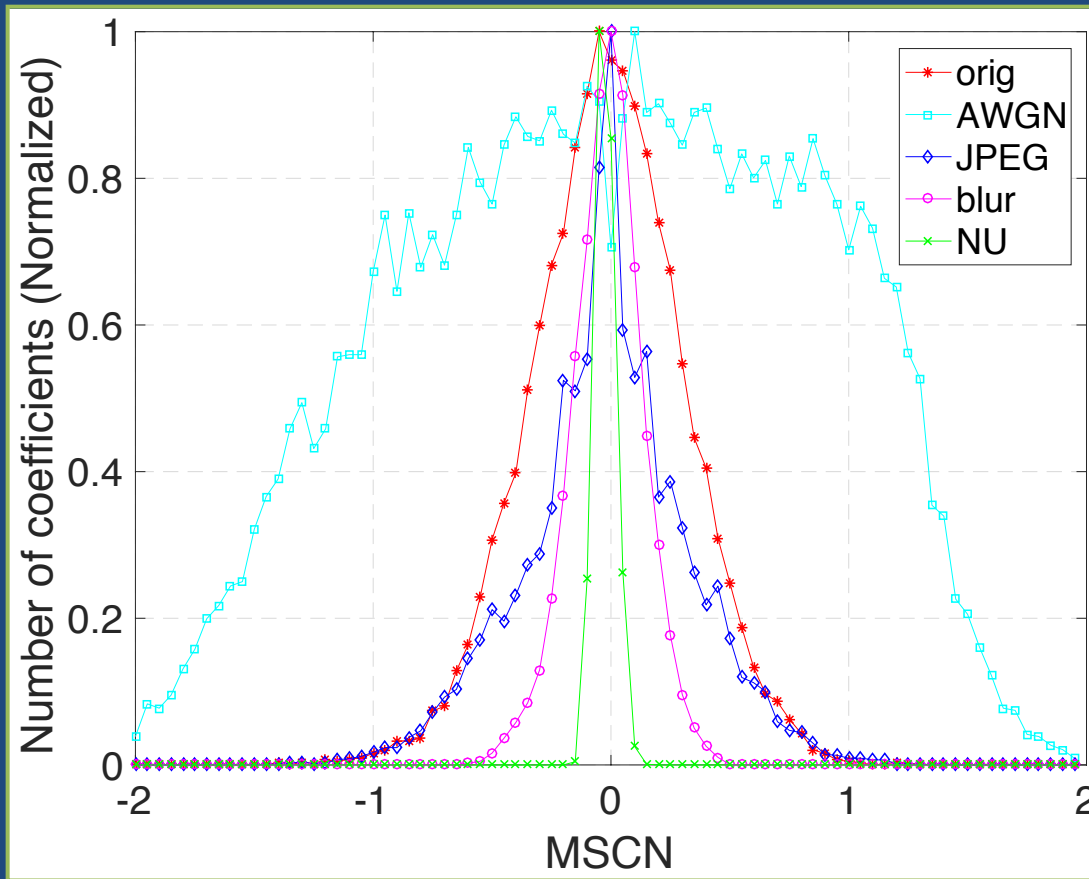
Zhou et al., IEEE Trans. Human-Machine Syst., 2014

Guzmán et al., IEEE J. Biomed. Health Inf., 2013

Infrared Image Quality



Natural Scene Statistics (NSS)



$$\hat{I}(i, j) = \frac{I(i, j) - \mu(i, j)}{\sigma(i, j) + C}$$

MSCN:

Mean Subtracted
Contrast
Normalized
coefficients

How do image
distortions affect
infrared face recognition
performance?

Can we improve IR face
recognition using
automatic Image Quality
Assessment (IQA)?

IR Facial Databases

IRIS



UND



PUJ-T360



University of Tennessee

University of Notre-Dame

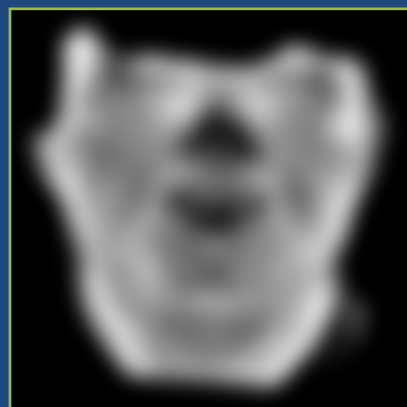
Image Distortions



Pristine



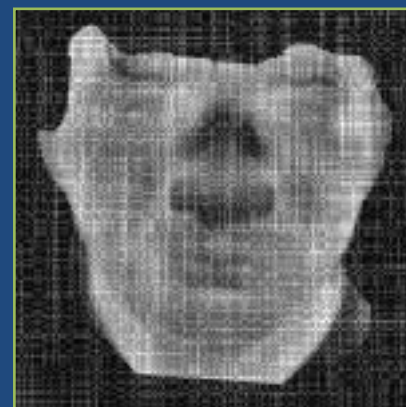
Additive White
Gaussian Noise



Blur

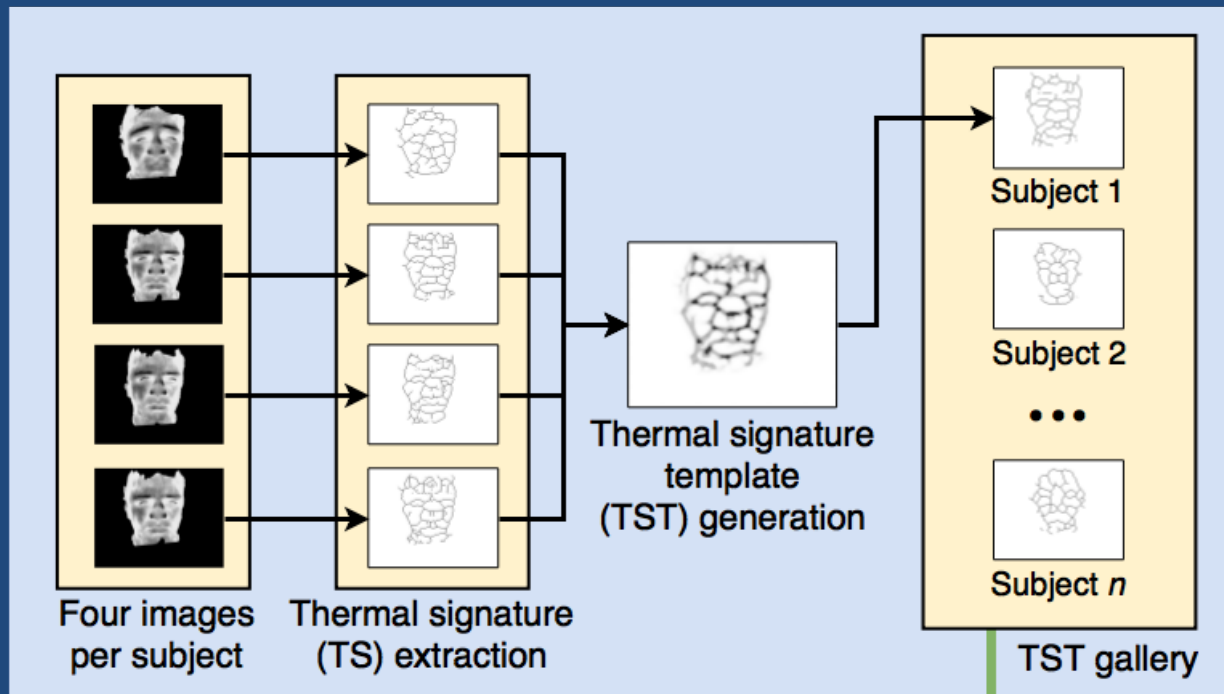


JPEG
Compression

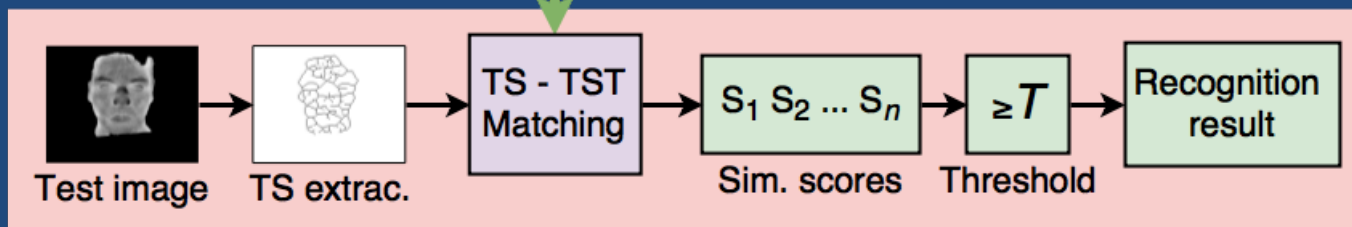


Non-Uniformity

IR Face Recognition based on Thermal Signatures

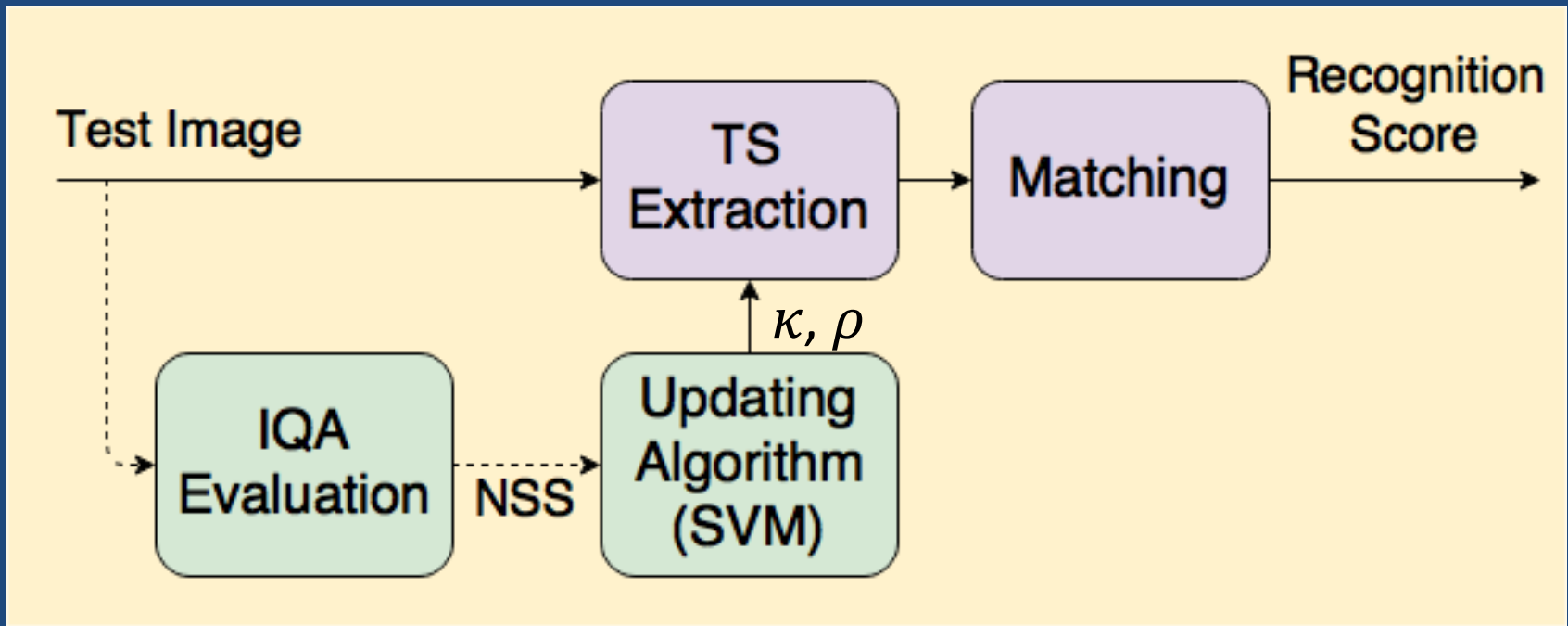


Offline phase



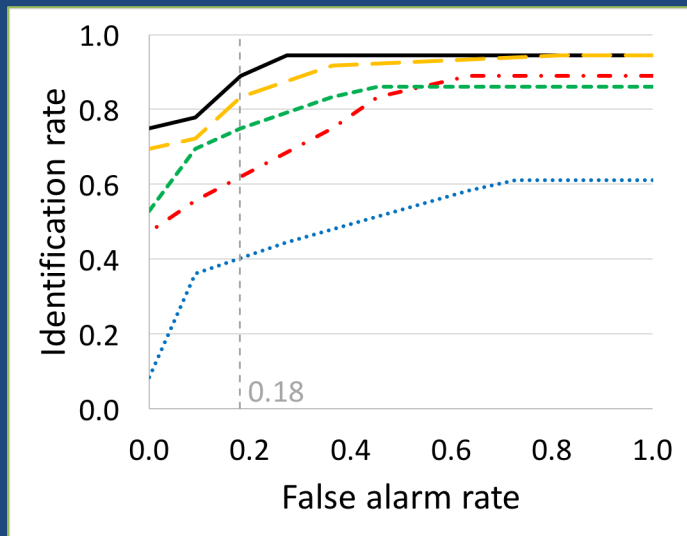
Online phase

Enhancement With Perceptual Quality-Aware Features

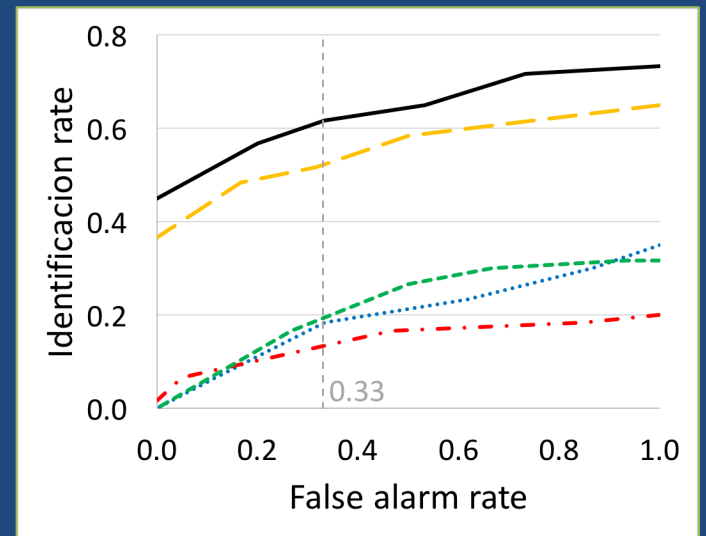


The TS extraction process is adapted to the type of distortion afflicting the input test image

Recognition Results Without NSS

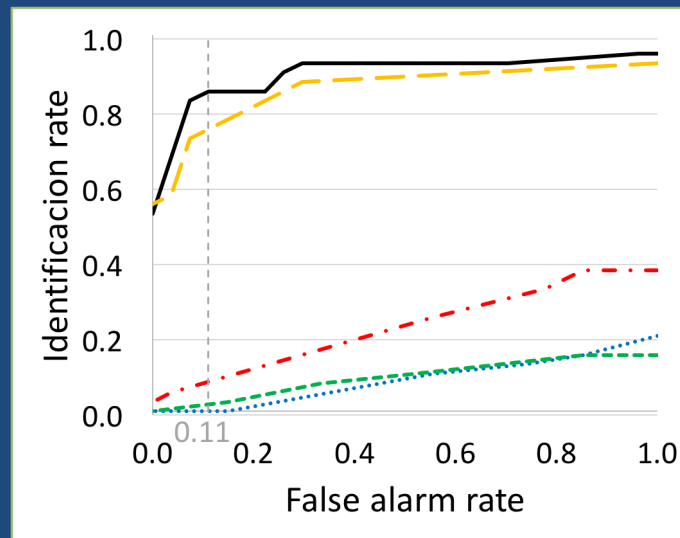


IRIS



UND

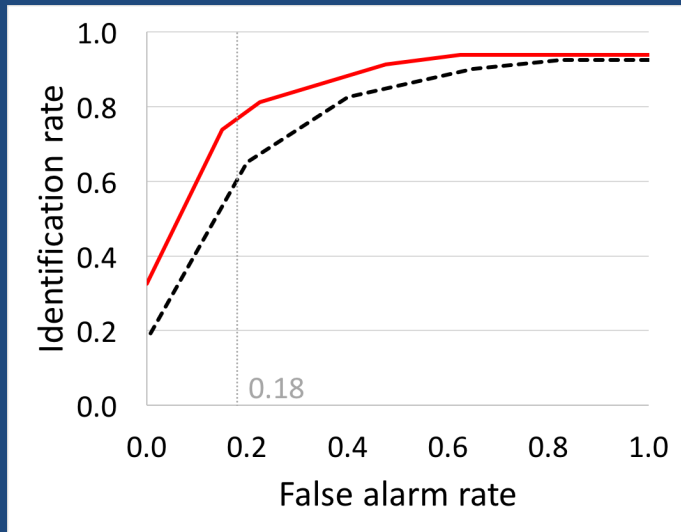
PUJ



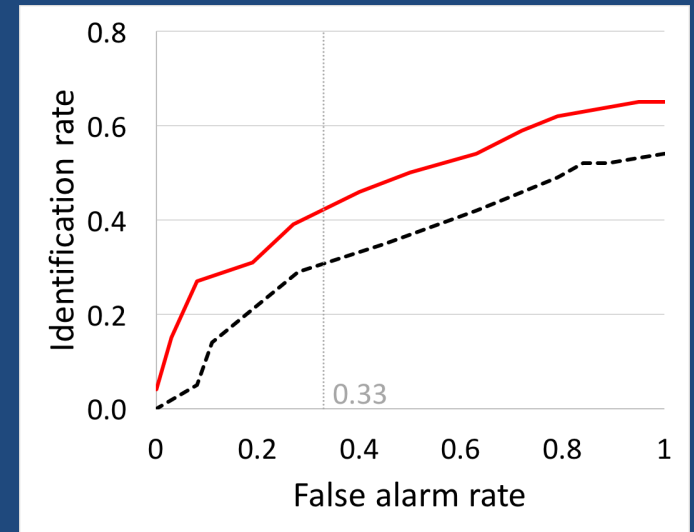
Recognition Degradation Without NSS

	IRIS	UND	PUJ
AWGN	-48%	-48%	-84%
JPEG	-5%	-8%	-11%
Blur	-26%	-48%	-77%
NU	-13%	-41%	-83%

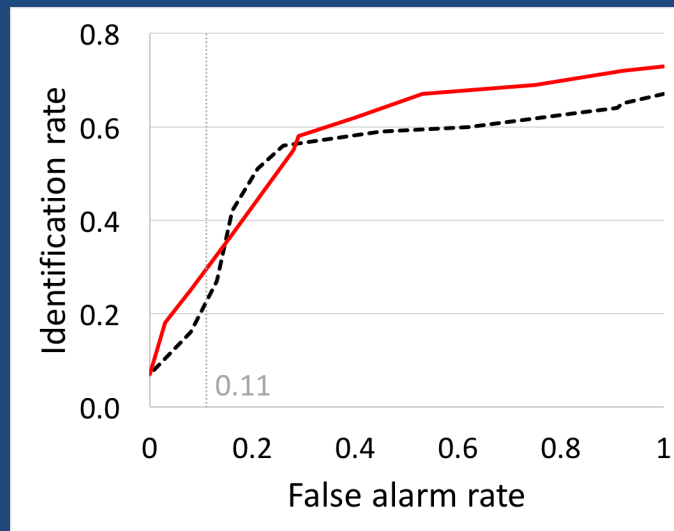
Recognition Results With NSS



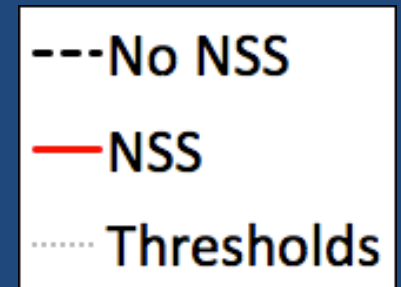
IRIS



UND



PUJ



Recognition Improvement With NSS

	IRIS	UND	PUJ
Pristine	5%	3%	0
AWGN	20%	17%	10%
JPEG	3%	5%	9%
Blur	28%	31%	9%
NU	3%	17%	10%
Mixed	17%	11%	19%

Conclusions

- Accuracy of IR face recognition decreases with image distortions.
- Natural Scene Statistics work for IR images.
- Aggregating NSS to an IR face recognition increases accuracy.
- Inclusion of IQA features can boost the applicability of IR face recognition systems.

Future work

- Explore other IR face recognition approaches.
- Automatic face registration and more precise face segmentation.
- Deeper study on parameters and recognition interdependency.
- Alternative methods to aggregate quality-aware features to IR face recognition.

Aknowledgments



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Ciencias de la Computación

The University of Texas at Austin



Laboratory for Image & Video Engineering



Summary

Contributions:

- Strategy for enhancing an IR face recognition system with quality-aware features.
- New thermal facial database.

Results:

- Quantification of performance degradation of an IR face recognition method tested on four common image distortions.
- Successful improvement in recognition accuracy by adding NSS features to an IR facial recognition approach.



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