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Comparison of Compression Algorithms' Impact on Fingerprint and Face Recognition Accuracy

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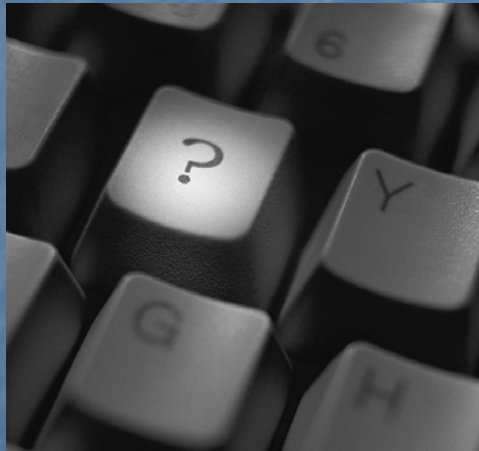
Andreas Uhl

Presentation Structure

- 1 Introduction
- 2 Experimental Studies
- 3 Results
 - 3.1 Results of Fingerprints
 - 3.2 Results of Faceprints
- 4 Conclusion

1 Introduction

- Boom of Biometric Systems
- How to store the acquired sensor data?



1 Introduction

Motivation of Compression

- Storage of Reference Data
 - Storing only extracted features
 - (+): smaller amount of data
 - (-): Re-Enrollment in case of replacement
 - Storing the original sensor data
 - (+): more flexible
 - (-): large amount of data
- compression technology*

1 Introduction

Motivation of Compression

- Transmission after sensor data acquisition
 - Acquisition stage dislocated from matching stage
 - Transfer over a wireless network link

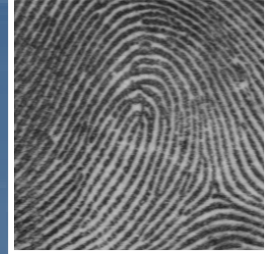
→ *compression technology*

1 Introduction

Compression Technology

- Lossy techniques
 - (+): Maximizes benefit
 - (-): Artifacts could interfere
 - FRR and FNMR will increase
 - FAR and/or FMR might be affected

*Our Focus: lossy compression of fingerprint
and face images*



1 Introduction

Fingerprints Characteristics

- High energy in high frequency bands
- WSQ standard adopted by the FBI
 - Superior to JPEG
 - Further Wavlet based approaches
- Only a few studies about matching rates of Biometric Systems available



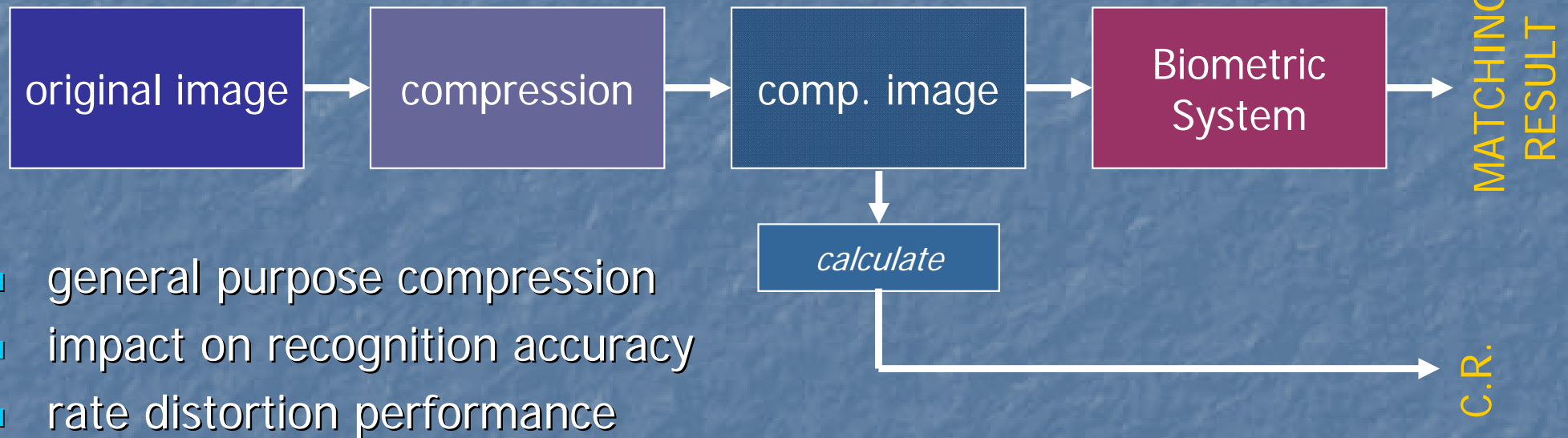
1 Introduction

Characteristics of Faceprints

- Typical average image data
- Most energy in low and medium bands
- No specific compression format needed
- JPEG and JPEG2000

2 Experimental Study

Experimental Setup

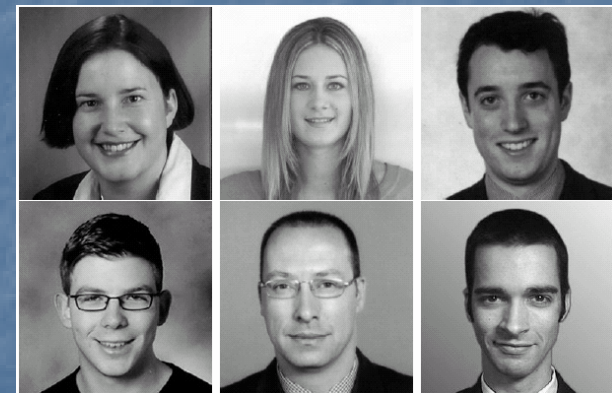
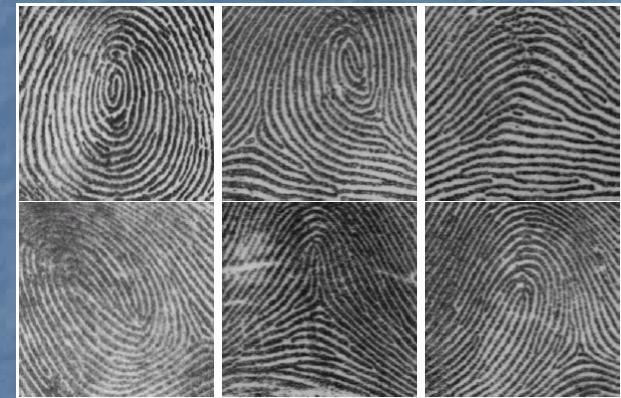


Final goal: ranking of compression schemes

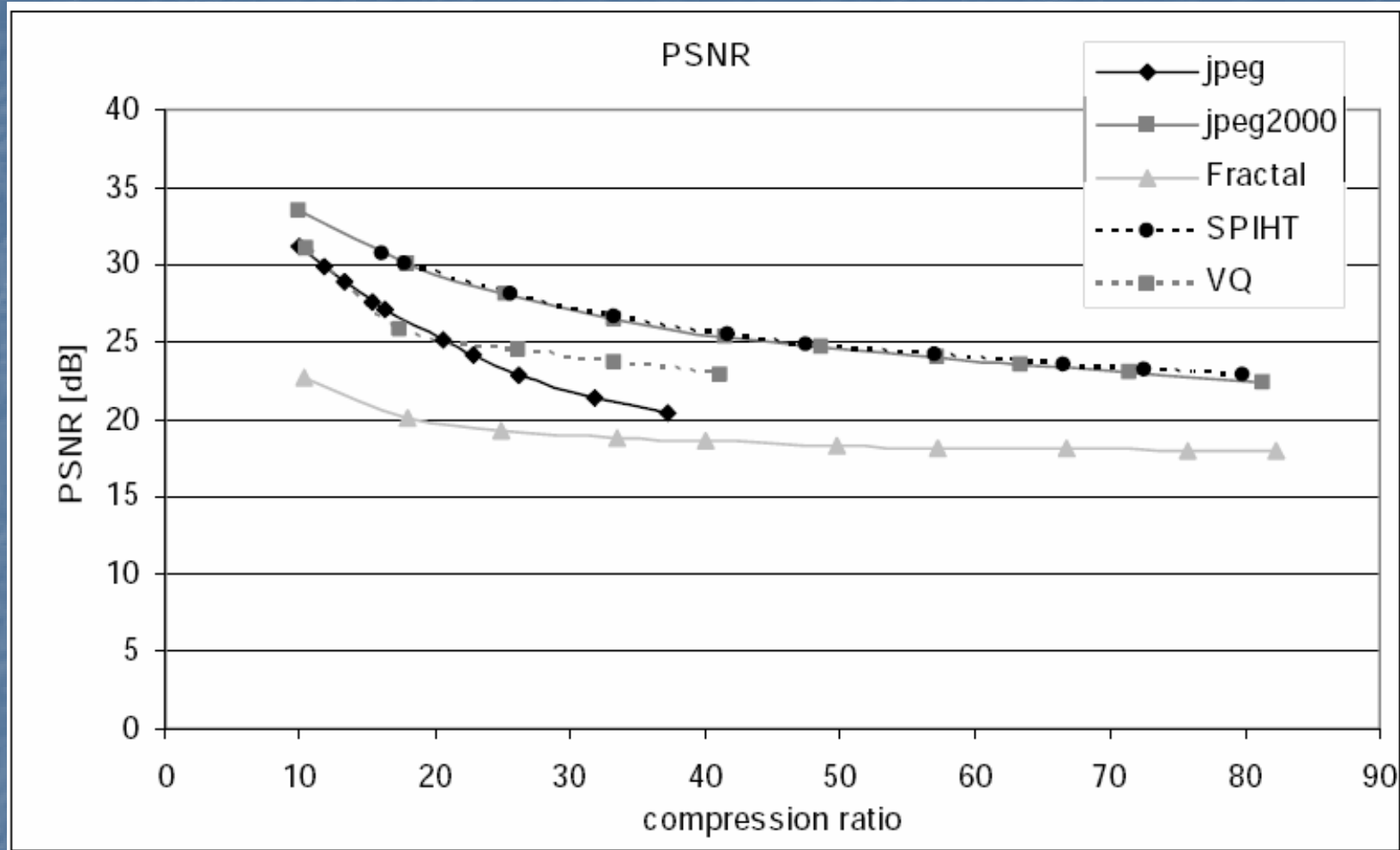
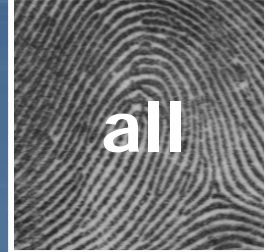
2 Experimental Study

Settings and Methods

- Sample Data:
 - 256 x 256 pixel
 - 8bpp (grayscale)
 - Fingerprints from sample database
 - Frontal faces from several databases

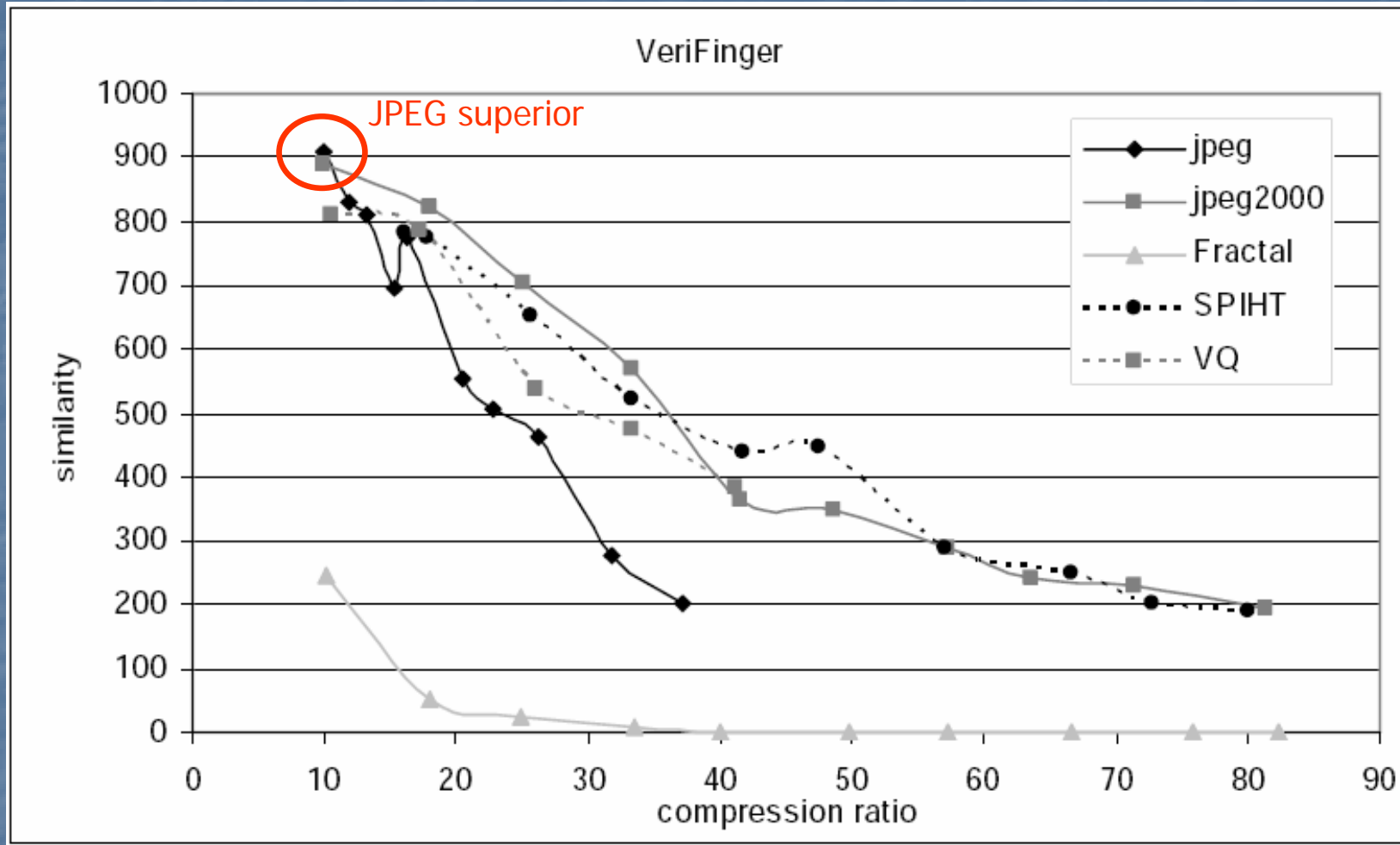
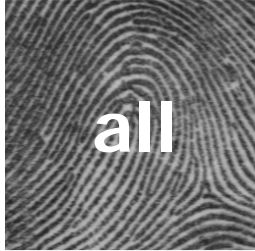


3.1 Average Rate Distortion Performance over all Images



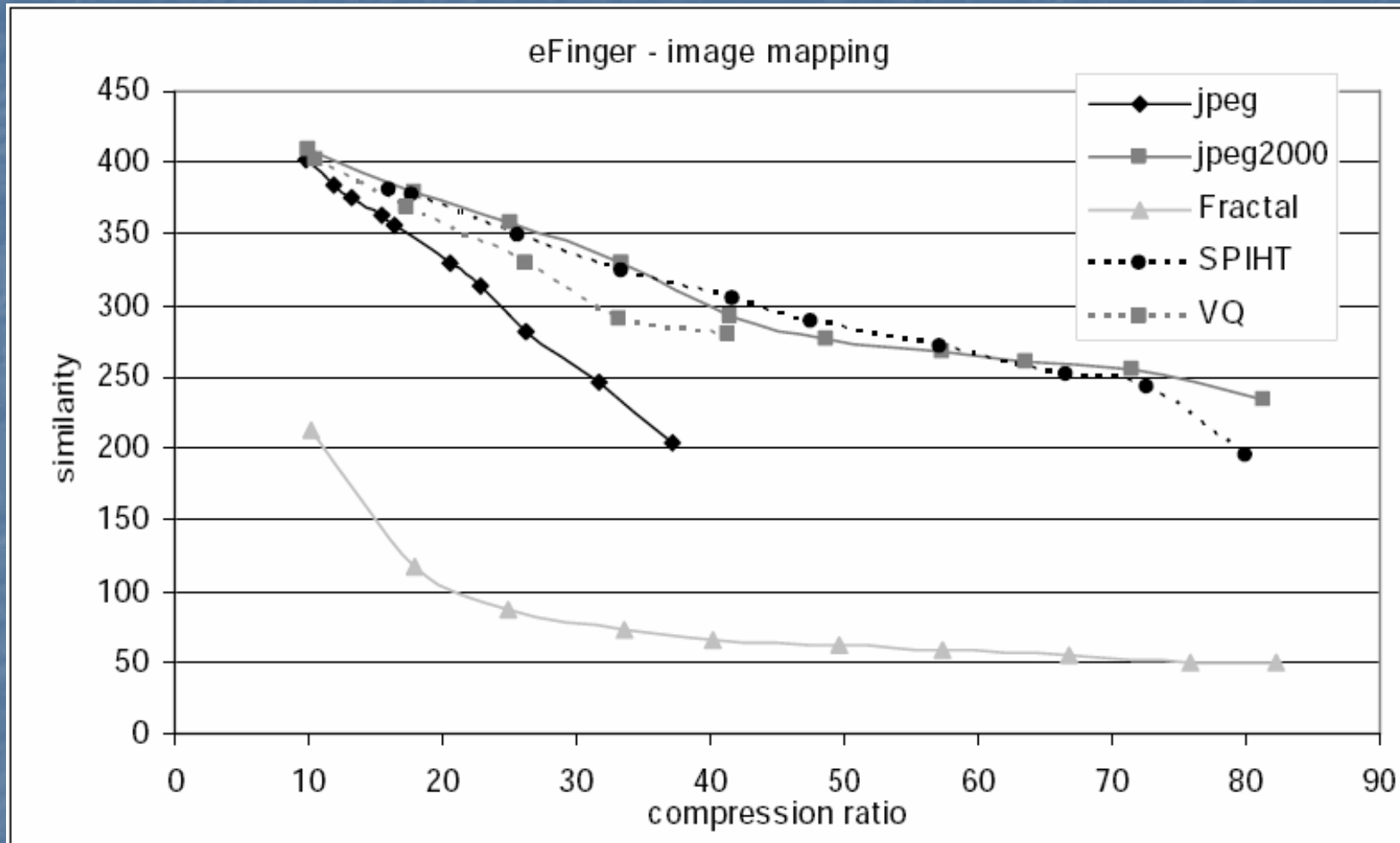
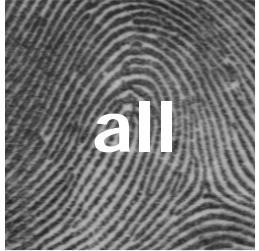
- Averages PSNR across all images
- JPEG2000 and SPIHT behave similar
- VQ and JPEG equivalent up to 20 c.r.
- Poor results: fractal compression
- Note: Absolute PSNR values are rather low
- Not easy to compress

3.1 VeriFinger results (averaged)



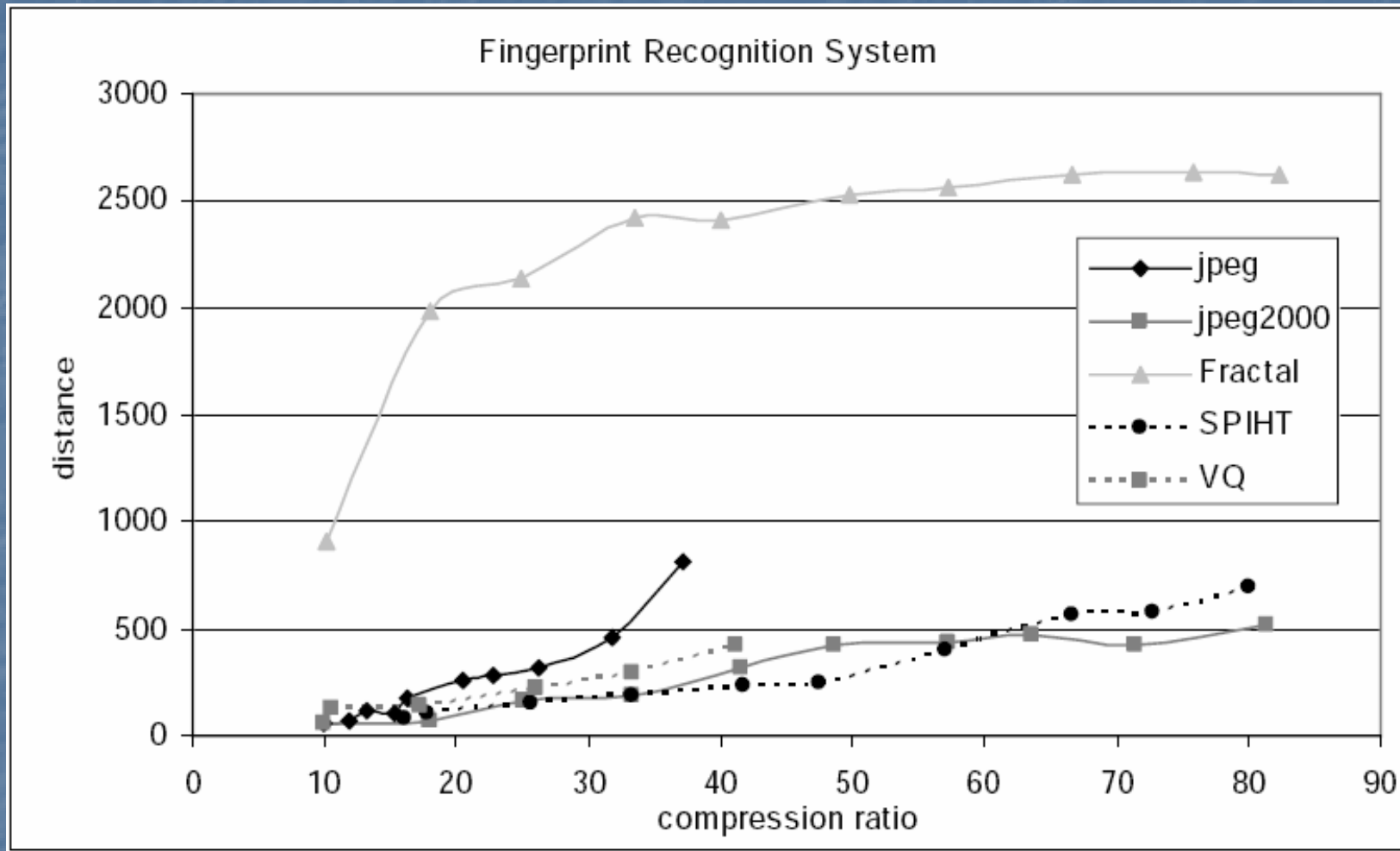
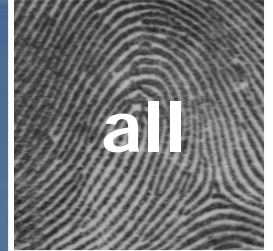
- JPEG superior at c.r. = 10
- Overall: JPEG2000 and SPIHT outperform others

3.1 eFinger results (averaged)



- JPEG2000, SPIHT, VQ corresponding to PSNR
- JPEG below Vector Quantization
- Fractal compression delivers poor results

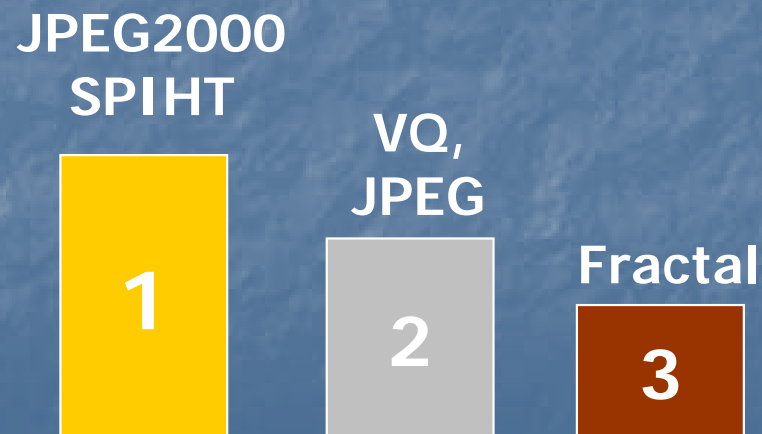
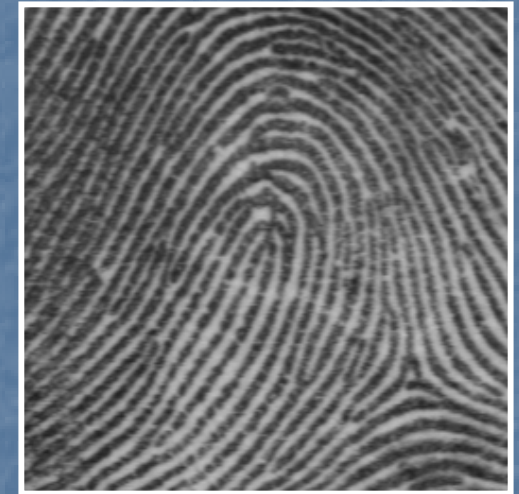
3.1 FiRS results (averaged)



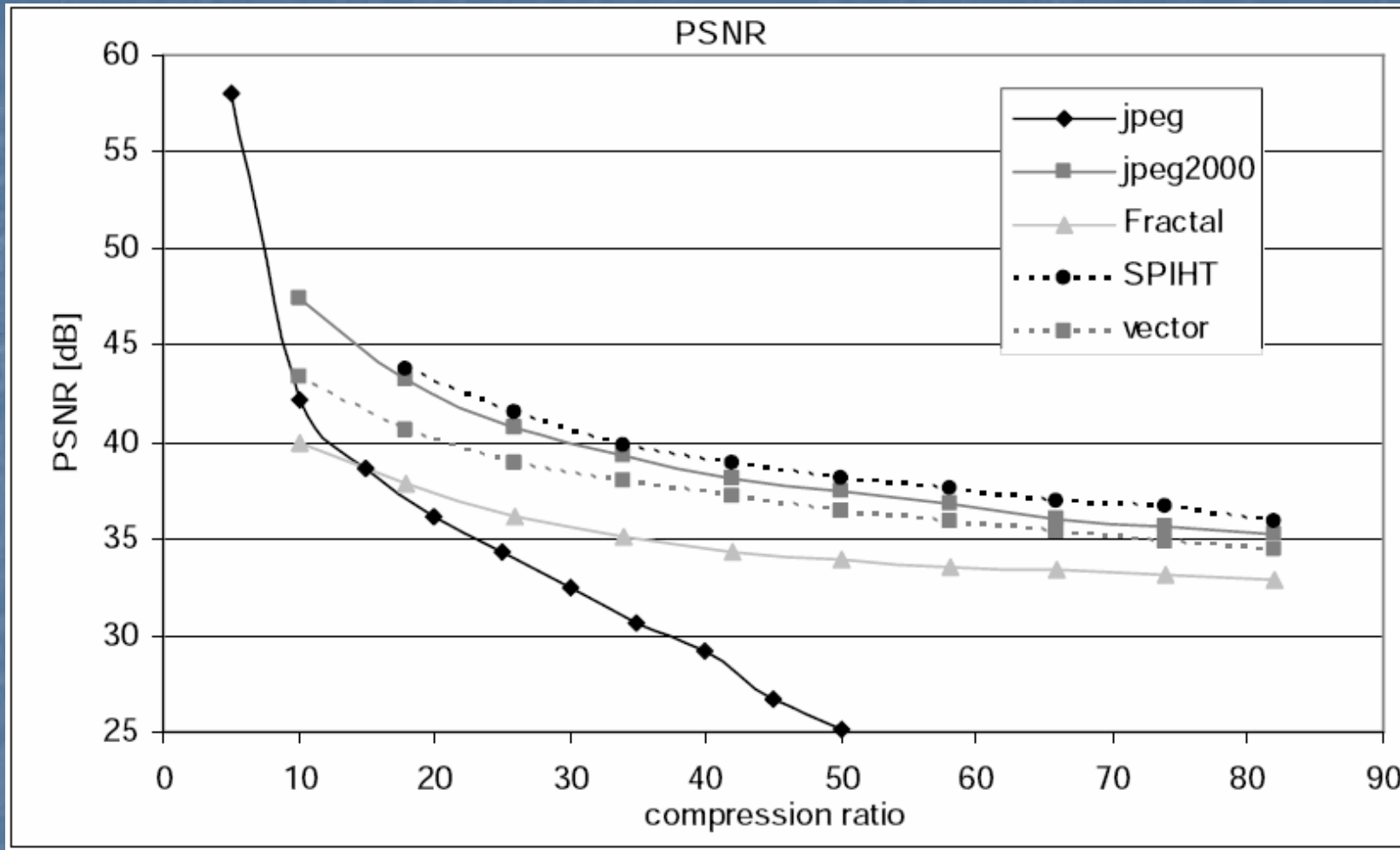
- Similar to eFinger System (note: y is *distance*)

3.1 Conclusion of the Fingerprint section

- PSNR is satisfying, but not perfect
- Top ranked algos exhibit top performance
- Fractal compression obviously not suited
- Vector Quantization does surprisingly well, superior to JPEG – in contrast to PSNR values
- JPEG at low compression ratios performs well

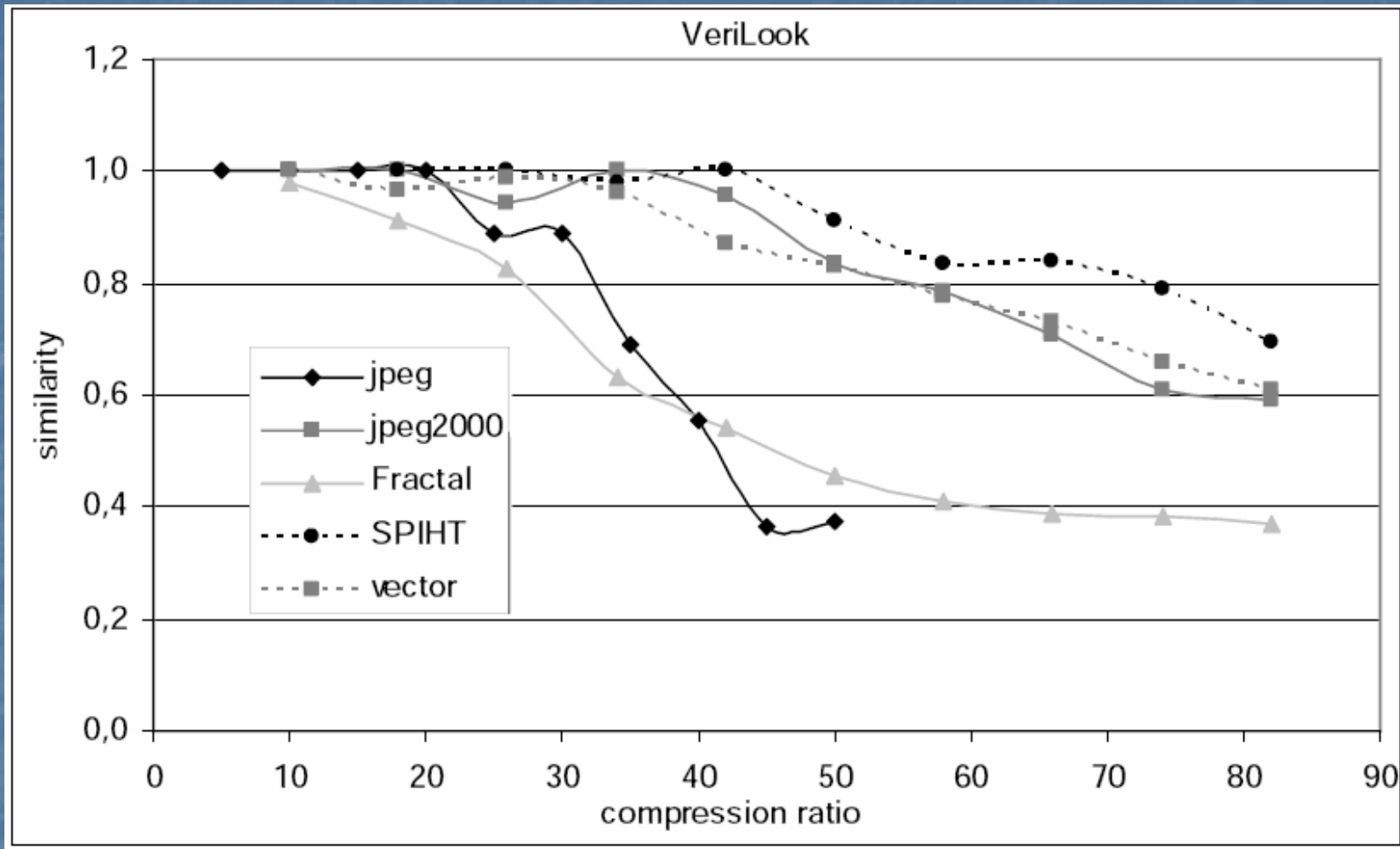


3.2 Average Rate Distortion Performance over all Face Images



- PSNR values significantly higher
- SPIHT outperforms JPEG2000 by ~0.5dB
- Vector Quantization is ranked 3rd
- Fractal is superior JPEG at low bitrates

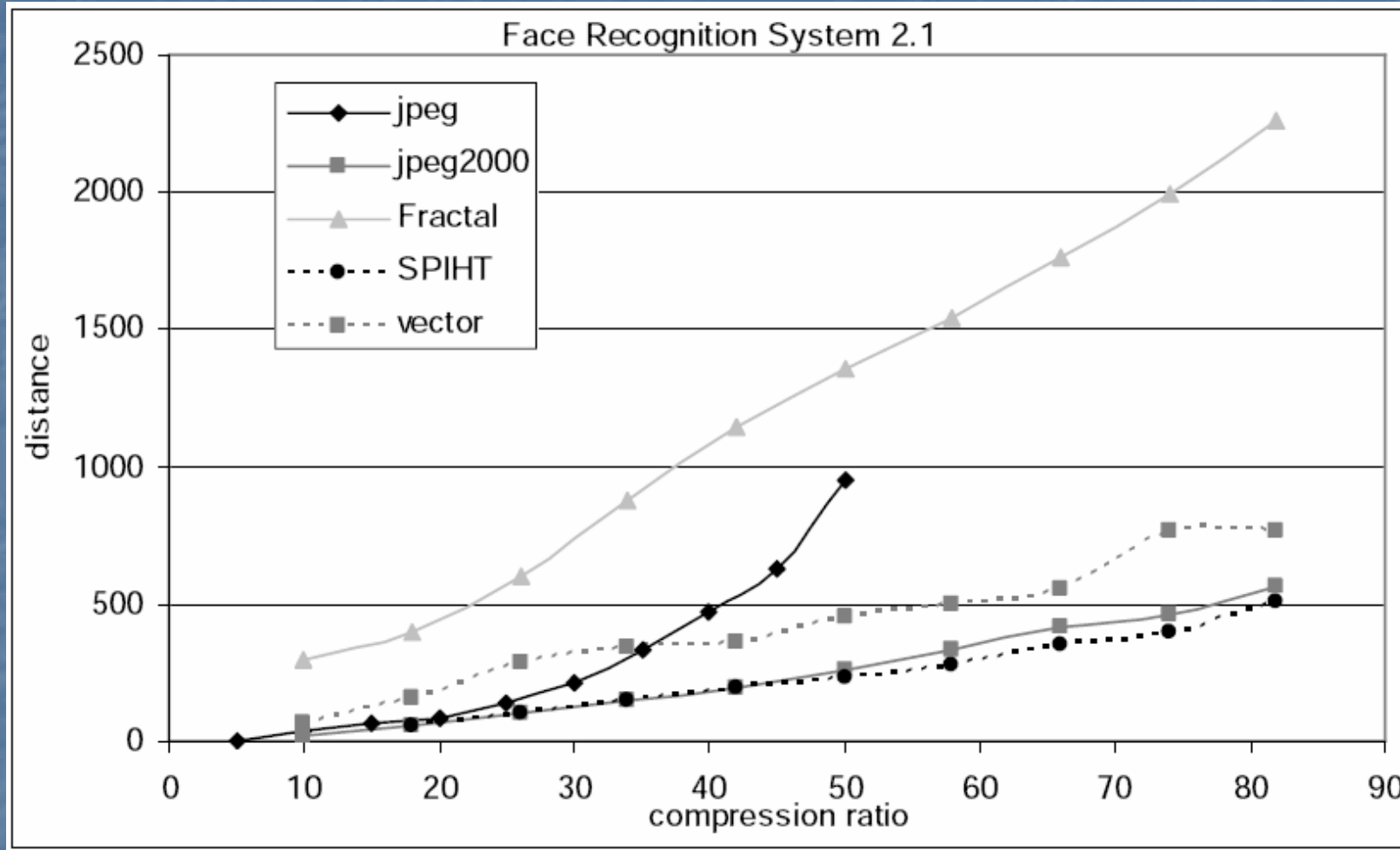
3.2 Averaged (over all images) VeriLook results



- JPEG > Fractal compression (below 40 c.r.)
- JPEG > Vector Quantization (below 20 c.r.)
- VQ slight above JPEG2000 (in contrast to PSNR)



3.2 Averaged (over all images) FaRS results



- Score corresponds to PSNR values for JPEG2000, SPIHT, PRVQ
- JPEG does well compared to ist PSNR values
- Fractal compression performs worse, unlike at PSNR

3.2 Conclusion of the Face image section



- PSNR is a less reliable indicator for face recognition
 - Although face images exhibits more „common“ properties
- JPEG's performance in face recognition systems is underestimated when looking at PSNR only
- Similar to fingerprinting Fractal Compression is the least suited algorithm
- Like PSNR values predict, JPEG2000 and SPIHT perform well

4 General Conclusion

- PSNR is a good indicator for wavelet based compression algorithms ...
 - ... and predicts poor scores of Fractal Compression
- Face images:
 - JPEG performs better than Fractal at high and medium bitrates
- JPEG2000, SPIHT, VQ are suitable
- JPEG and Fractal Compression could affect parameters

Thank you for your Attention!

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on behalf of:

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