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

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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

\(\Rightarrow\) 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
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 Wavelet 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

- general purpose compression
- impact on recognition accuracy
- rate distortion performance

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

Note: Absolute PSNR values are rather low
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 algorithms 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 its 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 exhibit 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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