Effects of JPEG XR Compression Settings on Iris Recognition Systems

Kurt Horvath[1], Herbert Stögner[1], and **Andreas Uhl**[1,2]

[1]School of Communication Engineering for IT, Carinthia Tech Institute, Austria
[2]Department of Computer Sciences, University of Salzburg, Austria
Contact author e-mail: uhl@cosy.sbg.ac.at

Motivation

Compression can be required in biometric systems, e.g. for storage of compressed templates on IC cards. For sample data, compression technology may be applied in two stages of the processing chain in classical biometric recognition for example:

- Transmission of sample data after sensor data acquisition for transfer to the feature extraction and matching module and
- Optional storage of (encrypted) reference data in template databases.

The distortions introduced by lossy compression artifacts usually interfere with subsequent feature extraction and may degrade the matching results. In particular, FRR or FNMR will increase (since features of the data of legitimate users are extracted less accurately from compressed data) which in turn affects user convenience and general acceptance of the biometric system. In extreme cases, even FAR or FMR might be affected. Therefore, careful selection and optimization of compression schemes is a must.

Iris Image Compression

ISO/IEC 19794-6 allows iris image data to be stored in lossy manner in the JPEG2000 format. In a former version, also JPEG was recommended.

WHY JPEG XR ?

- significantly lower computational demand as compared to JPEG2000 and
- in the medium to high quality range, JPEG XR delivers subjectively comparable or even better image quality.

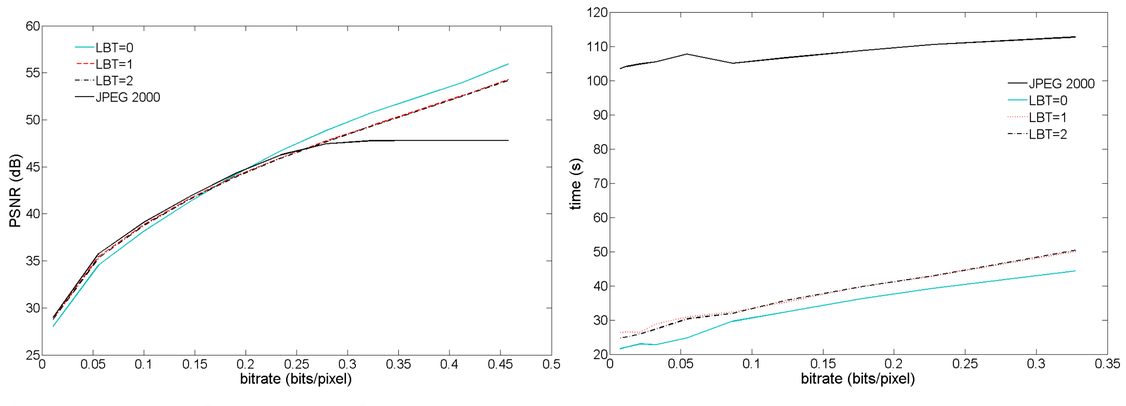

Fig. 1 PSNR and Time Results, JPEG2000 vs. JPEG XR.

Fig. 1 visualizes a comparison of JPEG2000 and three variants of JPEG XR, with respect to different settings concerning the use of the optional Photo Overlap Transform (POT) in addition to the Photo Core Transform (PCT) as a part of JPEG XR's overall Lapped Biorthogonal Transform (LBT):

- **LBT=0:** POT is disabled for both PCT stages
- **LBT=1:** POT is enabled for the first PCT stage but disabled for the second PCT stage
- **LBT=2:** POT is enabled for both PCT stages

Note that PCT is very similar to a 4x4 DCT, while the POT is designed to reduce blocking artefacts.

Experimental Settings

- **Dataset:** the CASIAv3 Interval dataset consisting of 320×280 pixels images of 391 subject classes.
- **Iris Recognition:**
  - A wavelet-based approach proposed by Ma et al. (DWT maxima and minima are encoded into a bit code)
  - A 1-D version of the Daugman iris recognition algorithm similar to Libor Masek's Matlab implementation (the phase of Gabor responses is encoded)
  - Spatial domain encoding by Ko et al. (sign change of cumulative pixel sums are encoded)
  - Zhu et al. extract statistical features (mean, variance) from wavelet subbands

Experimental Results

Fig. 2 shows equal error rates (EER) of the four considered iris recognition systems for different compression bitrates, comparing the uncompressed case (horizontal line) to JPEG2000 and the three JPEG XR settings.

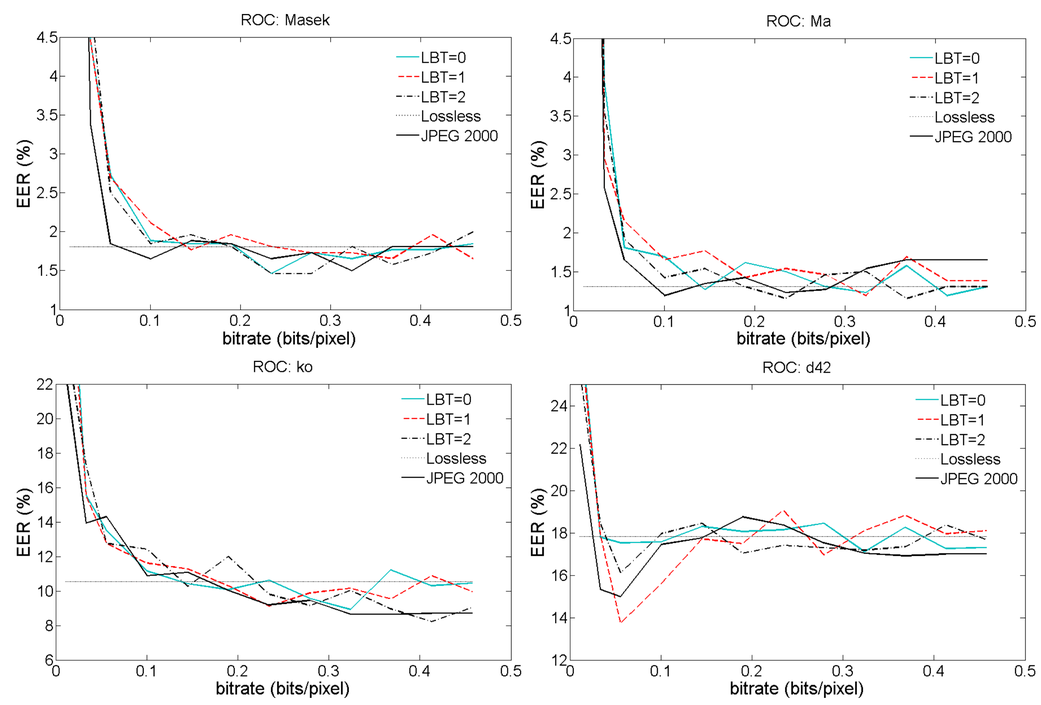

Fig. 2 EER results of four different feature extraction techniques.

Observations

⟶ JPEG XR is competitive to JPEG2000 in terms of EER for a wide range of bitrates (except for low bitrates in the results of two techniques).

⟶ There is no clear tendency which of the three JPEG XR settings provides the best recognition results.

⟶ Significant result degratation as compared to lossess is seen for very low bitrates only, in a wide range of bitrates recognition accuracy is even improved (due to denoising effects of compression).

Conclusions

JPEG XR is an interesting alternative to JPEG2000 in the context of iris biometric systems due to its high speed and competitive results with respect to recognition accuracy.