

Structure of the Test data

The IITD iris database has been acquired in an (claimed) uncompressed format from IITD and compressed with the listed compression ratios using single and double compression:

- CR 10
- CR 30
- CR 50

The following compression techniques are used:

- JPEG
- JPEG2000
- JPEG-XR

For the double compression, the first compression step is a JPEG-compression with

- 70%
- 75%
- 85%
- 100%

Quality parameter respectively. (Note that Quality 75% corresponds to the compression applied to the data in the CASIA Interval databases)

Influence on Segmentation

Method of investigation

The influence of compression on the iris segmentation with the USIT's CAHT segmenter is examined by using the following error-rate metric:

Assume a segmentation image Y of $W \times H$ pixels with pixel values y . There is an uncompressed Y_0 and a compressed image Y with these dimensions. Presuming Y_0 is the ground truth, then the segmentation error rate of a single image Y is computed as

$$y \in Y \text{ with } y \in \{0, 1\}$$

$$f(a, b) = \begin{cases} 1 & a = b \\ 0 & a \neq b \end{cases}$$

$$segErrRate(Y, Y_0) = \frac{1}{WH} \sum_{x=0}^{W-1} \sum_{y=0}^H f(Y(x, y), Y_0(x, y))$$

However, a closer look on the formula suggests a much nicer implementation using element wise XOR of the matrices and building the mean. This is possible, because the pixel values of Y obtain either 0 or 1. Hence the $segErrRate(Y, Y_0)$ is

$$segErrRate(Y, Y_0) = \overline{Y \oplus Y_0}$$

As a ground truth Y_0 the segmentation results of the uncompressed database are used. By averaging the segmentation error rate over all images ($N=2240$) in the IITD database, we get the following plots:

Results

When looking at the results in the three plots Figure 1, Figure 2 and Figure 3 the following conclusion could be drawn:

For JPEG2000 (Figure 3), it does not make much difference whether a certain compression ratio CR is achieved in a single or in a double compression step (curves are close). Especially not for a first compression with quality 100%, albeit there's minor differences for all the other FC qualities.

However, for JPEG (Figure 1) and JPEG-XR (Figure 2) as a compression method discrimination between achieving a certain CR with a single compression step can be seen. Therefore, results for compression algorithms which are computed by using already compressed data bases as an input data set (i.e. the CASIA interval dataset) are not entirely correct. This is, because if applied to uncompressed data, this behaves different than if applied (in testing) to already pre-compressed data bases, such as for the CASIA interval, which is JPEG-compressed with quality 75%.

Therefore the CASIA stuff corresponds to the Double with FC 75% graphs in the figures below.

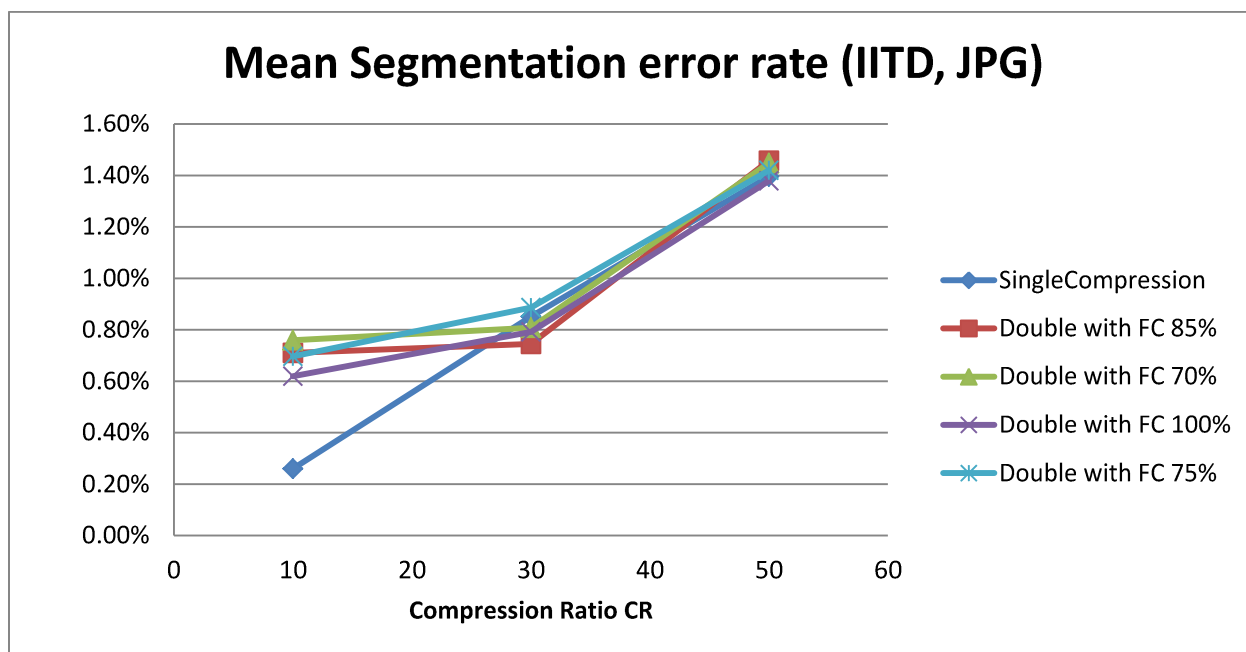


Figure 1: Segmentation error rate for JPG compression

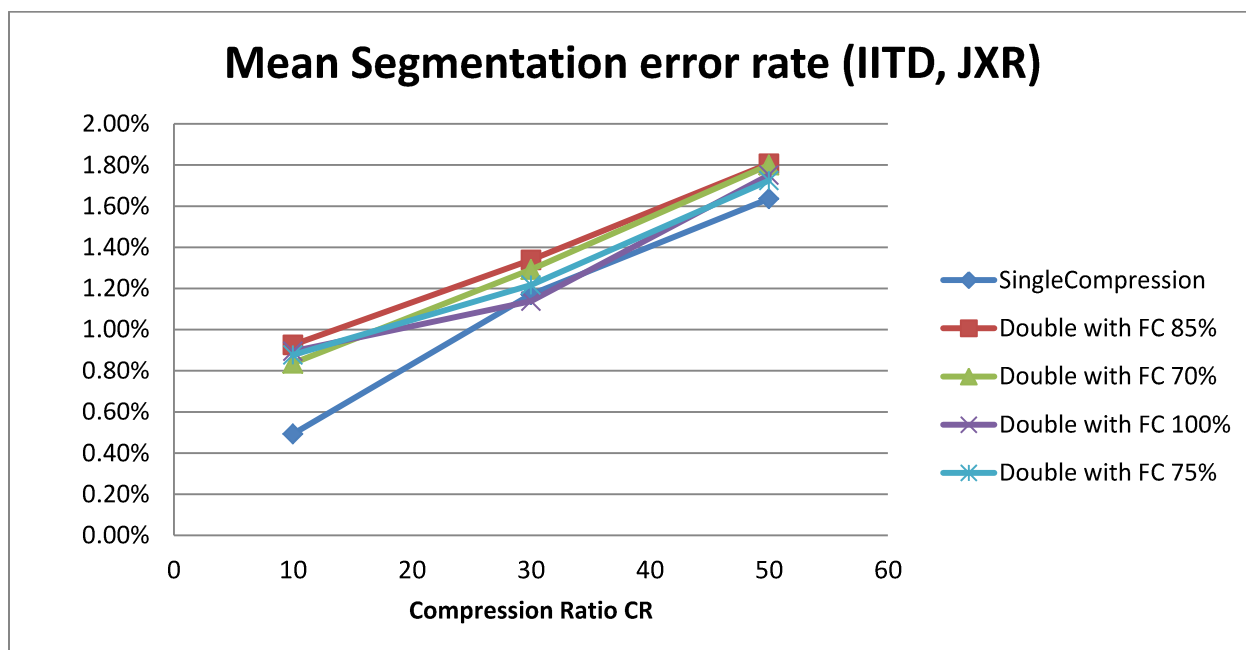


Figure 2: Segmentation error rate for JPEG-XR compression

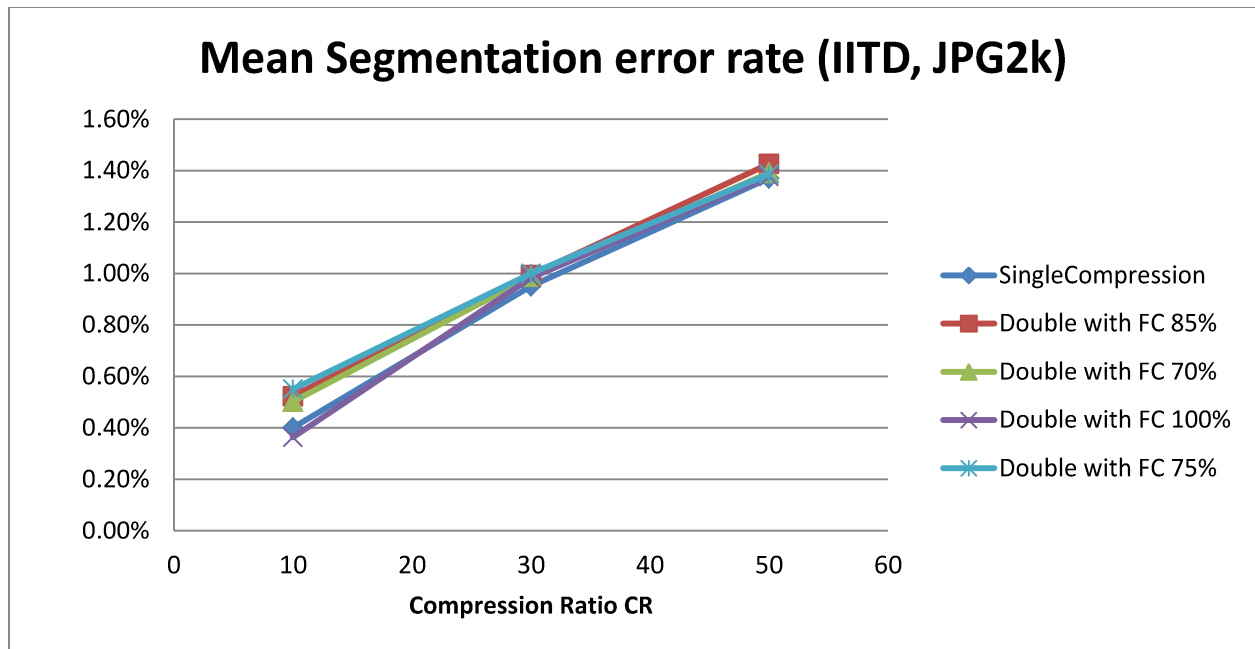


Figure 3: Segmentation error rate for JPEG2000 compression

Influence of an Iris detection system (EER)

Method of investigation

For EER on iris recognition systems see other sources or paper “Influence of sensor aging on iris recognition”

Also good source:

<http://www.griaulebiometrics.com/en-us/book/understanding-biometrics/evaluation/accuracy/matching/interest/equal>

For computing, the CAHT segmentation (see before) and Ma et al’s algorithm QSW has been used on the data.

Results

Well, the results here are rather surprising! The previous section showed that the segmentation error rate of the single compression method is always among the lowest (or is the lowest).

Quite interestingly, the EER of the single compression is not always the lowest, which would have been expected if the error is mostly linked to segmentation errors. Hence, this means, albeit segmentation errors are made, the compression artifacts in the iris texture influence the accuracy of an iris detection system more.

Still open to discussion

CASIA statement

Since cassia is compressed with 75% JPEG, this corresponds to the “Double with FC 75%” curve. For plain JPEG compression, the EER is consistently low at 1.5% over all Compression ratios – which I consider to be really suspicious. Also for JPEG2000 it is strange that EER decreases with decreasing quality of the image. The only reasonable curve is seen for JPEG-XR.

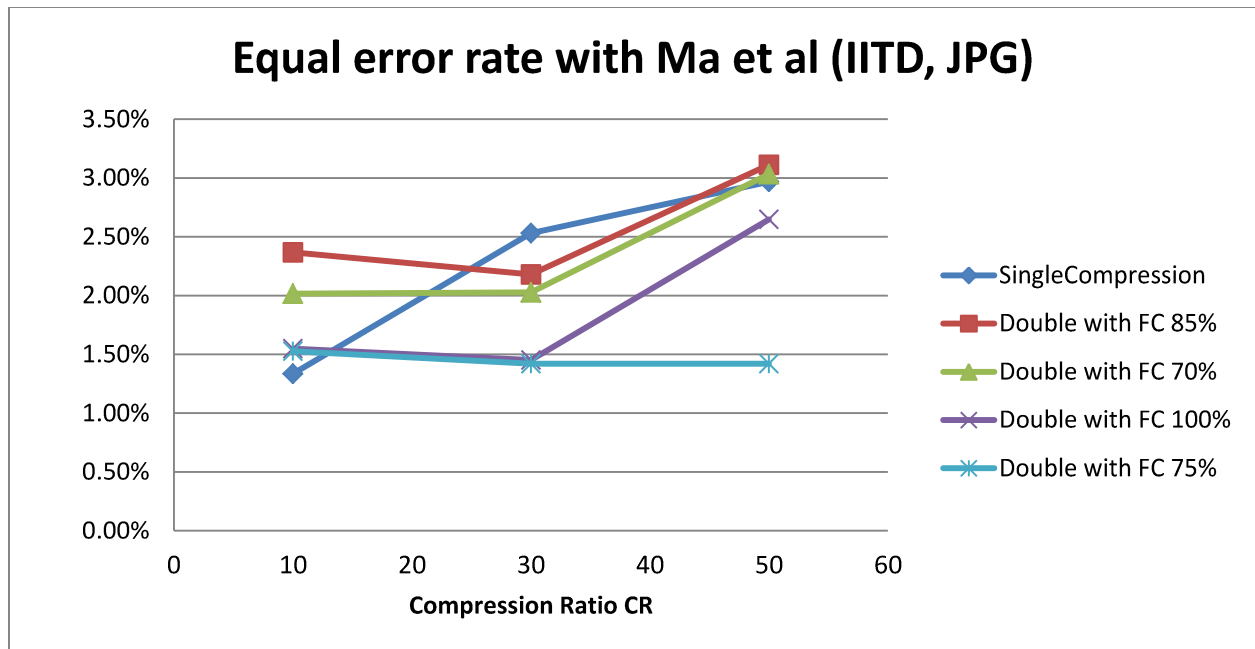


Figure 4: Equal error rate for JPG compression

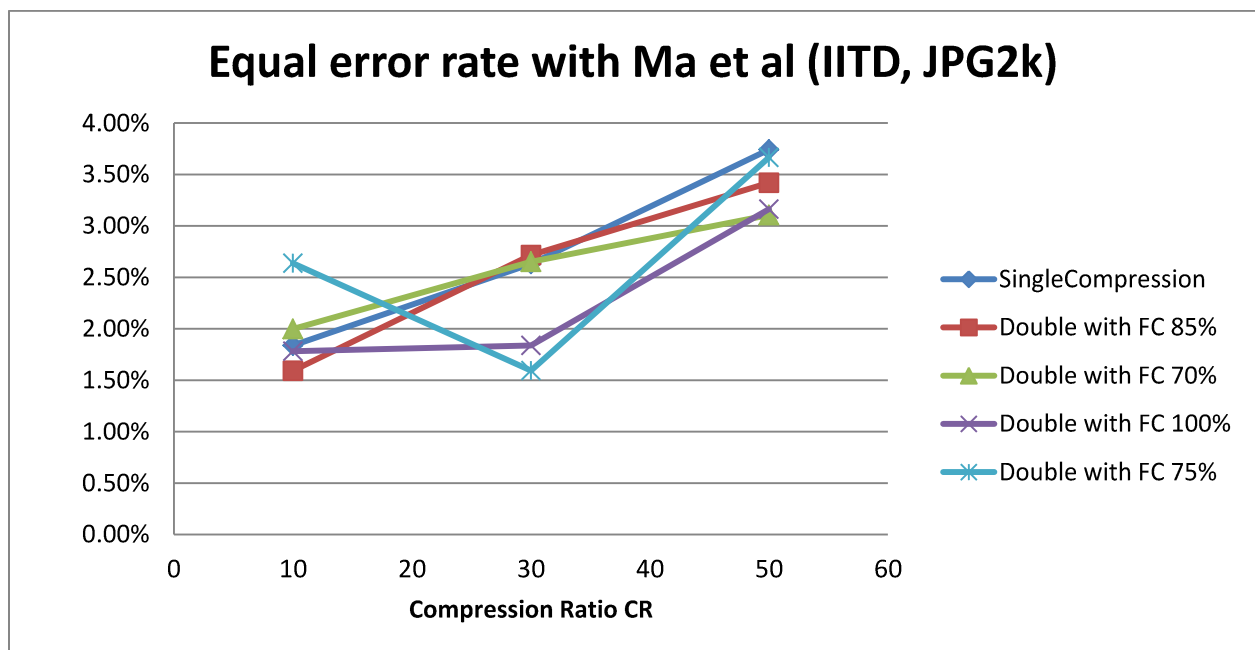


Figure 5: Equal error rate for JPEG-XR compression

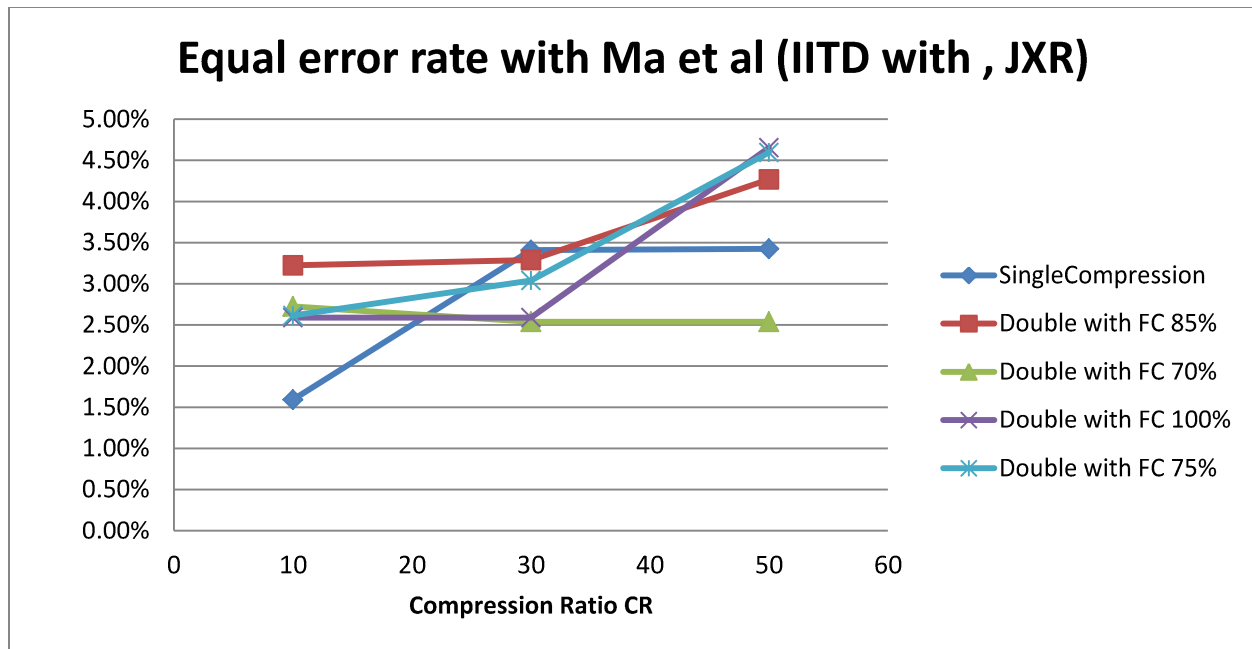


Figure 6: Equal error rate for JPEG2000 compression