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Recompression Effects in Iris Recognition[☆]

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Abstract

Rating a compression algorithms' performance is usually done in experimental studies, where researchers have frequently used JPEG pre-compressed data. It is not clear yet, if results of such compression experiments are reliable when conducted on pre-compressed data. To investigate this issue, we first study the impact of using pre-compressed data in iris segmentation and evaluate the relation between iris segmentation performance and general image quality metrics. In this context we propose a method to overcome potential problems in case using pre-compressed data sets cannot be avoided. As the second step, we conduct experimentation on the entire iris recognition pipeline. We find that overall, recognition accuracy results might not be entirely reliable in case of applying JPEG XR or JPEG2000 to JPEG pre-compressed data.

1. Introduction

Iris recognition [1, 2] is one of the most deployed biometric modalities, standardised by the International Civil Aviation Organisation (ICAO) for use in future passports, and one of the technologies in the Unique Identification Authority of India's (UID) Aadhaar project to uniquely identify Indian citizens. The increasing market saturation of biometrics instead of conventional access control methods raises the need for efficient means to store such data. The International Organisation for Standardisation (ISO) specifies iris biometric data to be recorded and stored in (raw) image form (ISO/IEC FDIS 19794-6) rather than in extracted templates (e.g. iris-codes). Such deployments benefit from future improvements (e.g. in feature extraction stage) which can be easily incorporated without re-enrollment of registered users. Since biometric templates may depend on patent-registered algorithms, databases of raw images also enable more interoperability and vendor neutrality [2]. These facts motivate detailed investigations and optimisations of image compression on iris biometrics in order to provide an efficient storage and rapid transmission of raw biometric records. Furthermore, the application of low-powered mobile sensors for image acquisition, e.g. mobile phones, raises the need for reducing the amount of transmitted data.

As a consequence, according to the importance of this issue, many studies comparing and optimising lossy compression techniques for iris imagery may be found in literature. Since the CASIA iris datasets have been very popular among researchers ever since their establishment, many papers dealing with compression have been relying on the (extended) CASIA V1.0 dataset, including also first IREX investigations [3, 4, 5, 6, 7] (apart from other examples using the ICE 2005 dataset [8, 9]).

Since it has been pointed out [10] that the CASIA V1.0 dataset exhibits manipulated pupil areas and should therefore not be used any further in experimentation, compression researchers moved to other (and more recent, more challenging etc.) datasets, e.g. the CASIA V3.0 [11, 2], the CASIA V4.0 [12], the Bath [4, 13], and the UBIRIS.v1 [6, 14] datasets. While the images of CASIA V1.0 and ICE 2005 are given in uncompressed format, images in CASIA V3.0, CASIA V4.0, UBIRIS and Bath datasets are provided as JPEG (the first three) or JPEG2000 (the latter) lossy compressed data. Therefore, any compression experiments conducted on these datasets operate on pre-compressed data. This fact has not been ignored entirely – for example, in [2], preparatory JPEG compression experiments with uncompressed data reveal that slightly pre-compressed data leads to better recognition performance due to denoising effects. Thus experiments with pre-compressed data are assessed to be unproblematic. The same argument is used for JPEG2000 pre-compressed data [13]: In [4] it was also shown that slight pre-compression with JPEG2000 improves recognition rates, thus JPEG2000 pre-compression is not seen problematic in any way. However, eventual artifacts resulting from recompression effects are not accounted for in these considerations. Recompression artifacts arise in cases where data is compressed twice (or multiple times) with lossy compression schemes, i.e. where artifacts from the first compression step (termed pre-compression) are aggravated or exploited by the second compression step.

Two different types of such effects may be distinguished: First, *homogeneous recompression*, where the same compression scheme is used several times, whereas in *heterogeneous recompression* different methods are used in the different compression steps. For example, in iris recognition, using JPEG pre-compressed data and applying JPEG XR and JPEG2000

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