Improved Elastic Storage of Digital Still Images

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We recently proposed elastic storage,1 a new solution for storing a variable number of images in a fixed storage space. Initially, when only a few images are stored, they are stored losslessly (or near-losslessly). When more images have to be added, the storage space occupied by the previously stored images is adjusted to fit in each new image. A variable amount of space is allocated to each image, depending on its complexity. The implementation is based on bit-rate scalable image compression methods (such as e.g. JPEG 2000), which enable the data for each new image to simply overwrite part of the data of previously stored images. Thus, the method operates without any decoding and re-encoding of image data on the storage medium.

The elastic storage strategy determines how the data of individual images is combined to be jointly stored on the storage medium. We have studied several strategies and found a new strategy that maximizes the minimum image quality, so it has a higher guaranteed image quality than any other strategy. Since the overall quality impression is often determined by the image with the lowest quality (i.e., the image in which compression artefacts will first become visible), the new strategy also improves the overall perceived quality. Our experimental evaluation for a digital still camera example shows that for the new strategy, compared to the original strategy (which maximized the average image quality), the minimum image quality (PSNR) increases by up to 2.3 dB, whereas the average image quality never decreases by more than 0.3 dB. Furthermore, the increase in minimum image quality is in all cases larger (and often much larger) than the decrease in average image quality. Therefore, the overall image quality impression is always improved. Compared to a traditional digital still camera that assigns the same storage space to each image, the new elastic storage strategy provides storage capacity gains ranging from 10% to more than 100%, depending on the selected images and desired guaranteed image quality level. Although it is therefore impossible to represent the capacity gain by a single number, our experiments indicate that a 40% increase in storage capacity can easily be demonstrated.

The new strategy is implemented by a simple modification of the compressed image data block significance values used for the elastic storage method.1 Therefore, all basic operations (store, retrieve, delete) remain the same and the low complexity of the original strategy implementation is retained.

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