Effect of Coefficient Coding on JPEG Baseline Image Compression

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The lossy compression achieved by using the Cosine Transform in the JPEG image compression algorithm comes from quantizing the coefficients. Once quantized, the further compression achieved comes from the application of lossless compression techniques applied to the statistical redundancy of the transform coefficients. This work uses the example quantization table described in the JPEG drafts as the basis for comparing the amount of compression attributable to each of several distinct lossless compression techniques.

This study takes the JPEG algorithm apart into its constituent pieces. The result shows that most of the JPEG compression performance is achieved from coefficient quantization that replaces coefficient values comprised of many bits with values comprised of few bits. Additional compression is achieved by a combination of runlength coding, predictive coding, and either Huffman or arithmetic coding.

Several test image results are presented. The notion of one-pass techniques use either predetermined statistics for all data, or dynamic adaptation, made possible by adaptive Huffman coders, the Ziv-Lempel technique, or an adaptive arithmetic coder. Two pass techniques, on the other hand, gather the statistics on a first pass, place the coding parameters in the header of the compressed file, and compress the data according to its own statistics. The two approaches are discussed and compared. The algorithm compress, based on the LZW algorithm, is compared to the Huffman coding, and arithmetic coding of the transform coefficients. This presentation summarizes and extends the results in [1].