PERCEPTUALLY LOSSLESS IMAGE COMPRESSION

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There are many instances in which human observers are the final judges of the quality of a compressed image. In such situations, it is useful to incorporate a model of the human visual system (HVS) into the image compression system in order to reduce or even eliminate the visual distortions introduced to the reconstructed image. A compressed image is said to be perceptually lossless for a specified viewing distance if the reconstructed image and the original image appear identical to human observers when viewed from that distance. It is important to recognize that the perceptual quality of an image is a function of the viewing distance, and consequently the notion of perceptually lossless compression is also a function of the viewing distance.

This paper presents an algorithm for perceptually lossless image compression. Our approach utilizes properties of the human visual system in the form of a perceptual threshold function (PTF) model [1]. The perceptual threshold function model determines the amount of distortion that can be introduced at each location of the image. Thus, constraining all quantization errors to levels below the PTF results in perceptually lossless image compression.

Our system employs a modified form of the embedded zerotree wavelet (EZW) coding algorithm [2] that limits the quantization errors of the wavelet transform coefficients to levels below those specified by the model of the perceptual threshold function. The perceptual threshold function was obtained for the wavelet decomposition employed in the EZW algorithm experimentally in a manner similar to that described in [1]. Modifications made to the EZW algorithm include stopping the coding process as soon as all the wavelet transform coefficients are coded to levels within the threshold values suggested by the PTF. Experimental results demonstrate perceptually lossless compression of monochrome images at bit rates ranging from 0.4 to 1.2 bits per pixel at a viewing distance of six times the image height and at bit rates from 0.2 to 0.5 bits per pixel at a viewing distance of twelve times the image height.

REFERENCES

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