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A SEPARATE TEXTURE/EDGE IMAGE CODING SYSTEM

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Abstract

Digitised pictures have both cosmetic and scientific image aspects. This thesis presents an image coding system that compresses monochromatic digital image information in such a way that the cosmetic—or viewed—image aspects of a reconstructed picture are indistinguishable from the original to a (human) observer. The coding system is concerned with viewed aspects of digitised images and is based on a simplified 2-channel model of the human eye, with the image information being separated into slowly varying texture information and rapidly changing edge information corresponding to those two channels.

Each of the two types of image data is coded using techniques suited to its individual characteristics. Texture information is coded using predictive waveform coding where the predictive filter coefficients are generated by linear predictive coding (LPC) techniques. Since the waveform prediction is not perfect, this thesis evaluates several different methods of differential pulse code modulation (DPCM) coding the residual prediction error. This signal is then used to improve the texture coding quality.

Image edges are isolated from the digital image data by an asymptotically optimal edge detector known as the Laplacian of Gaussian (LOG) filter. Using two image edge models, the LOG isolated edges produce contours which are used to define edge position, shape, and “sharpness”. The edge position data is then compressed using a chain-coding system. The thesis also considers the effect the edge characteristics have on the coding system and develops two methods for reducing the number of coded edges.

Reconstruction of the coded image is in two parts corresponding to the two channels of the coding system. The texture information is reconstructed by predicting texture pixels and adding the decoded DPCM error signal. Edge information not

contained in the texture coding channel is reconstructed using only edge information corresponding to the high spatial frequency channels of the human eye. These two channels are added together producing the final coded image reconstruction. Also considered are the effects of varying the original image sampling density.

The 2-channel coding system is applicable to a wide variety of images, producing coded images with a high visual quality and coding bitrates as low as 0.6 bits/pixel (256×256 pixel images), while maintaining a relatively low computational overhead both at the encoder and the decoder.

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To Sarah

The unsung hero.

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Glossary

Coded Image: Coded version of the digital image.

Difference Signal: The residual error in the LPC prediction of the texture image pixel intensity using previous *reconstructed* pixels during prediction.

Digital Image: Original image scene digitised and represented by a 2-dimensional array of pixel intensities.

Edge Image: Image edge information isolated by Laplacian of Gaussian filtration on the digital image.

Edge Map: 2-dimensional boolean array with a logic true at a pixel location if an edge point exists there.

Edge Point: Location of an edge in the digital image; corresponds to a zero-crossing in the edge image.

Edge Response Contour: The edge response contour produced by Laplacian of Gaussian filtration on an image edge.

Error Signal: The residual error in the LPC prediction of the texture image pixel intensity using previous *original* pixels during prediction.

Texture Image: Image texture information isolated from the digital image.