**OPTIMISATION OF STILL IMAGE COMPRESSION TECHNIQUES.**

submitted by David Bethel

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**Abstract**

This thesis explores the area of still image compression, improves on existing techniques and develops new image compressors. Initially the different techniques used to implement image compressors are discussed in relation to their specific application to images. Low complexity transforms are then examined and their parameters are optimised. The truncated Discrete Cosine Transform (DCT) is investigated and is shown to be more efficient than corresponding polynomial functions. Incorporating fractals is shown to improve the performance of the DCT further but this has the effect of increasing the complexity of the system. This thesis then goes on to propose a limited searching fractal technique that out-performs all the other low complexity methods investigated. The low complexity transforms are applied to hierarchical structures which further improves their performance. A new method is demonstrated that partitions an image ready for compression and this shows improvement over previous work in this area. The centred parent fractal methods are then investigated and they are shown not to be effective in a low complexity quad-tree coder. The method of optimal source coding is discussed, along with the details of practical implementations, and then optimal source coding is applied (with linear quantisation) to both the DCT and wavelet transforms. A high-complexity variable coefficient DCT is discussed which expands on the ideas of the truncated DCT and the quad-tree. Both standard JPEG and the well-known Shapiro Embedded Zero-tree Wavelet (EZW) are implemented for comparison to the new method and it is found that the optimally quantised DCT is better than both of these methods.

This thesis investigates the whole area of image compression and optimises the techniques where applicable to produce the best compressor possible. In general it is found that increasing the complexity of the compression method improves the rate distortion performance of the method but it does so at the expense of the speed of the compressor. It was also found that the transform stage of the compressor was not as important as an effective source coding stage.

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**Statement of Originality**

The author considers the following elements of this work to form his original contribution:

Chapter 2

* The discussion of quantisation.

Chapter 3

* The optimisation of low complexity transform parameters.
* The development of the Limited searching method.
* The comparison of increasing levels of fractal complexity.
* The development of VQ error clear up using a rate distortion switch.

Chapter 4

* The development of the error sorting method.
* The use of reconstruction error calculated from orthogonal transform coefficients.
* The demonstration that a higher complexity partition does not improve image compression performance.

Chapter 5

* The application of the equal gradient method with linear quantisation.

Chapter 6

* The variable coefficient DCT.
* The optimal quantisation DCT.
* The comparison of the DCT methods discussed here.

Chapter 7

* The optimal quantisation wavelet.

Chapter 8

* The comparison of all the methods discussed here.
* The conclusion that the transform is not as important as the compression techniques.

**Overview**

In this work different types of still image compression will be examined and where possible improvements will be made to the performance of existing compressors or new techniques will be introduced. During the course of this work a number of papers were published on work relating to still image compression [1 - 6].

The aim of this work is to develop the best image compressor possible. To approach this task the basics of image compression were studied progressing from the most simple form of image compressors (low complexity transforms) right up to the full transform methods (DCT’s, wavelets). By examining the whole field of image compression insight was gained into developing effective compressors.

Throughout this work the greyscale image Goldhill is used as the test image for each coding method. The compressors have not solely been tested with the Goldhill image, but other images are only mentioned when they differ from the Goldhill result. In each chapter, unless otherwise stated, ‘the image’ refers to Goldhill.

The compression of colour images is a secondary consideration since only about 10-20% of the bit rate is needed to adequately describe the colour in a still image compressor. Therefore only greyscale images will be used when developing the still image compression methods.