

# Image Coder Based on Hilbert Scanning of Embedded quadTrees

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## Abstract

In this work we present an effective and computationally simple algorithm for image compression based on *Hilbert Scanning* of *Embedded quadTrees* (*Hi-SET*). It allows to represent an image as an embedded bitstream along a fractal function. Embedding is an important feature of modern image compression algorithms, in this way Salomon in [1, pg. 614] cite that another feature and perhaps a unique one is the fact of achieving the best quality for the number of bits input by the decoder at any point during the decoding. *Hi-SET* possesses also this latter feature. Furthermore, the coder is based on a quadtree partition strategy, that applied to image transformation structures such as discrete cosine or wavelet transform allows to obtain an energy clustering both in frequency and space. The coding algorithm is composed of three general steps, using just a list of significant pixels.

## Keywords

Fractals, Image Coding, Image Compression, Quadtrees, Wavelet Transforms.

## I. INTRODUCTION

The proposed coder makes use of a Hilbert Scanning, which exploits the self-similarity of pixels. Hence, applying a Hilbert Scanning to Wavelet Transform coefficients takes the advantage of the similarity of neighbor pixels, helping to develop a optimal progressive transmission coder. In this way, at any step of the decoding process the quality of the recovered image is the best that can be achieved for the number of bits processed by the decoder up to that moment.

## II. COMPARING *Hi-SET* AND JPEG2000 CODERS

*Hi-SET* is tested on the 24-bit-depth color images of the *Miscellaneous volume* of USC-SIPI image database. **Experiment 1**, gray-scale images (just  $Y$  component): Figure 1a shows the average quality of the recovered images as a function of compression rate, where the differences between JPEG2000 (continuous function with heavy dots) and *Hi-SET* (continuous function with heavy stars) are depicted. *Hi-SET* improves either the image quality in approximately 1.39dB with the same compression rate or bit-rate in approximately 0.22bpp with the same image quality. **Experiment 2**, color images ( $YCbCr$  components): Figure 1b shows the compression rate and their average quality. On the average, a  $512 \times 512$  image compressed by *Hi-SET* (continuous function with heavy stars) with 35dB is stored in 62.82KBytes at 1.963bpp, while JPEG2000 (continuous function with heavy dots) stores it in 87.97KBytes at 2.749bpp. On average, *Hi-SET* either compresses 0.29bpp more with the same image quality or reduces in 1.00dB the error with the same bit-rate.

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- [1] D. Salomon, *Data Compression: The Complete Reference*, 4th ed., ser. ISBN-13: 978-1-84628-602-5. Springer-Verlag London Limited, 2007.

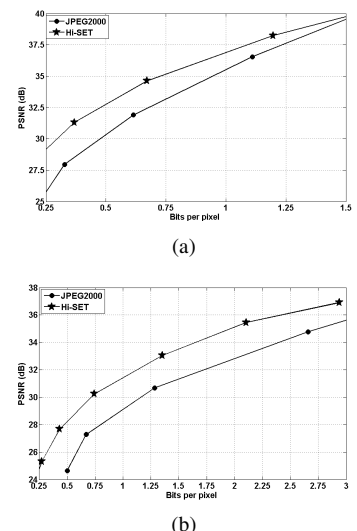


Figure 1. Compression Rate vs Image Quality between JPEG2000 and *Hi-SET*: (a) Gray-scale and (b) Color compression.