New Methods in Color Image Compression

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Abstract

We have developed a lossy and lossless compression method for color images based on the WDR and ASWDR methods for gray-scale images. New techniques were needed for handling the complexity of color images.

Requirements for Color WDR

Color De-correlation

- Colors should not rely entirely on the other colors
- Convert RGB into another color space

Enhanced Symbols

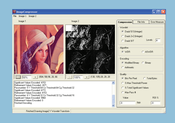
- Address encoding requires 3 symbols: Zero, One, and End of Address
- Sign encoding requires 3 symbols: Plus, Minus, and Zero
- Refinement encoding is done using a Run Length Encoder (RLE) to compress refinement bits

Color Wavelet Difference Reduction Algorithm (WDR) Algorithm

Color WDR Algorithm

- Perform wavelet transform on the 3 colors of the image
- Initialize threshold T for each color such that there is no value in the wavelet tranform >= 2*T
- Initialize scan order
- Significance Pass
  - Find a value in the wavelet tranform from any color where the transform value V satisfies 2*T>|V|>=T
  - Encode the address of the value
    - Encode the sign of the color 1 value
    - Encode the sign of the color 2 value
    - Encode the sign of the color 3 value
  - Store the quantized value in matrix qV for each color
  - Check is compression ratio / quality attained
    - If so end the procedure
  - Repeat until all values are found
- Refinement Pass
  - For every value in each color that was encoded previously where |V| >= 2*T
    - For each color individually
      - if |qV| + T <=V then
        - Encode a refinement bit stating refinement is needed
        - Update qV for that color with qV + sign(V)*T
      - else
        - Encode a refinement bit stating refinement is not needed
  - Check if compression ratio / quality is attained
- Set each T = T/2
- If all T<1 then end Procedure
- Loop to the Significance Pass

Implementation



Program Developed

- Compress/Decompress Greyscale and Color images with various quality settings
- Introduces an alternative to arithmetic compression using the enhanced symbolic encoder
- Provides different methods to control quality other than bits per pixel

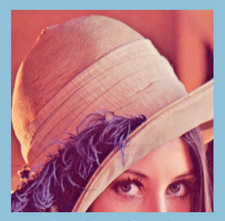
Results

The image compressor developed provides a viable way to compress color images. Images compressed using the Color WDR method compare very well against the JPEG 2000 standard. The image compressor program also serves as an educational tool for those who want to understand using wavelets in color image compression.

Lena

PSNR Lena

	Color WDR	JPEG2000
1.0bpp (24:1)	33.4140	34.3206
0.5bpp (48:1)	31.1806	32.2399
0.25bpp (96:1)	28.7584	30.0231



Original Image (Cropped)

Color WDR

1.0 bpp (24:1) 0.5 bpp (48:1) 0.25 bpp (96:1)PSNR Hats

JPEG2000

Hats

PSNR Hats (kodim03)

	Color WDR	JPEG2000
1.0bpp (24:1)	34.5423	39.9467
0.5bpp (48:1)	32.2151	35.9511
0.25bpp (96:1)	30.0086	32.6940

Original Image (Cropped)

Color WDR

1.0 bpp (24:1) 0.5 bpp (48:1) 0.25 bpp (96:1)PSNR Hats

JPEG2000

Image taken from: http://rok.us/graphics/kodak/

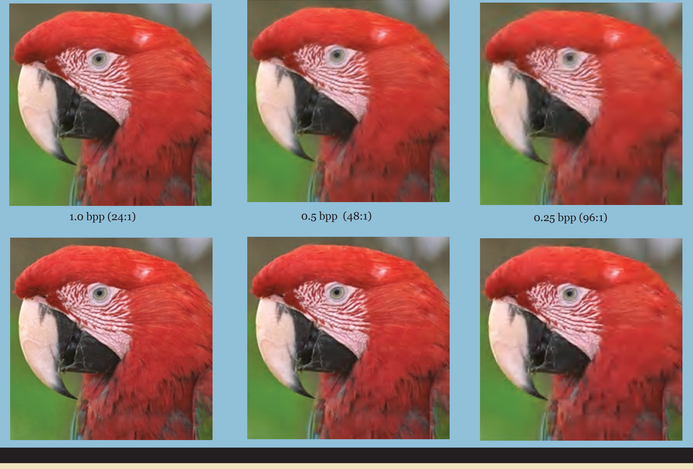
Parrots

PSNR Parrot (kodim23)

	Color WDR	JPEG2000
1.0bpp (24:1)	38.6077	40.5531
0.5bpp (48:1)	34.5994	37.5263
0.25bpp (96:1)	31.3319	34.2919

Original Image (Cropped)

Color WDR



1.0 bpp (24:1) 0.5 bpp (48:1) 0.25 bpp (96:1)

JPEG2000

Image taken from: http://rok.us/graphics/kodak/

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