

H-compress

<http://www.stsci.edu/ftp/software/hcompress/>
<http://www.projectpluto.com/fitscomp.htm>
<http://webscope.nfo.edu/data/H/hcompress>

Haar Transform in 2x2 blocks

a_{00} a_{10} Image Block

a_{01} a_{11}

Transform coefficients

$$h_0 \equiv \frac{1}{2}(a_{11} + a_{10} + a_{01} + a_{00})$$

$$h_x \equiv \frac{1}{2}(a_{11} + a_{10} - a_{01} - a_{00})$$

$$h_y \equiv \frac{1}{2}(a_{11} - a_{10} + a_{01} - a_{00})$$

$$h_c \equiv \frac{1}{2}(a_{11} - a_{10} - a_{01} + a_{00}).$$

Haar Transform in 2x2 blocks

- ◆ Construct a $2^{N-1} \times 2^{N-1}$ image from the h_c values,
- ◆ repeat the transform until only one value remains or N times
- ◆ The H-transform can be performed in place and requires about $16N^2/3$ additions for an NxN image.
- ◆ The transform is exactly reversible using integer arithmetic if one does not divide by 2 for the first set of coefficients

Basics

- ◆ h_x , h_y and h_c are mostly of 0 value thus a bit stream of 0s is expected.
- ◆ Use progressive transmission that refines the image at each successive transmission.
- ◆ This way is easy to accommodate to fluctuating bandwidth

Quantization

- ◆ Normalize coefficients:
 - Divide each coefficient by σ
 - ◆ Thus, eliminating the noise

Quad-Tree Coding

- ◆ Having 16 bit planes in 1001000111100000
- ◆ Divide to 4 quadrants
 - 1001 | 0001 | 1111 | 0000
- ◆ Code each quadrant with one bit
 - 1 if there is any one in the sequence
 - Otherwise, 0
- ◆ Next approximation: divide each quadrant into two parts, repeat to arrive to one bit

Huffman

- ◆ Fixed "Huffman" coding that uses 3 bits for quadtree values that are common (e.g., 0001, 0010, 0100, and 1000)
- ◆ 4 or 5 bits for less common values.
- ◆ This reduces the size by about 10% at little computational cost.

Problem

- ◆ WFC2 5MB image is acquired in ≈ 256 sec
- ◆ ACS WFC produces 32MB
- ◆ Bandwidth shared between data and commands : max 0.125Mbs.
- ◆ Each orbit of the earth lasts about 95 minutes, with the time divided between housekeeping functions and observation.
- ◆ ≈ 60 min for acquisition
- ◆ Buffer is to be of minimum size

Schedule for July

- ◆ Read H-compress paper (posted, Paper #3)
- ◆ Understand
 - Transform
 - Quantization
 - Coding
- ◆ Write the algorithm for each step
- ◆ Write the algorithm for decompression
- ◆ Write the code
- ◆ Simulate 1 hour image acquisition and random bandwidth fluctuation between 0.08 and 0.125 Mbs and for the buffer size 8, 16, 20 and 24 MB.
 - How many bits are stored and/or transmitted?

Schedule for July

- ◆ Mo and Wed 11:00am
- ◆ Other days by appointment
- ◆ Next week schedule will be defined

Next step

- ◆ Identification of slow parts and hardware realization
- ◆ Dr. Jiang will be consulting on that part