

CSE 490 GZ Introduction to Data Compression Winter 2002

Patents
Lapped Transform Artifacts
SPIHT Decoding Example

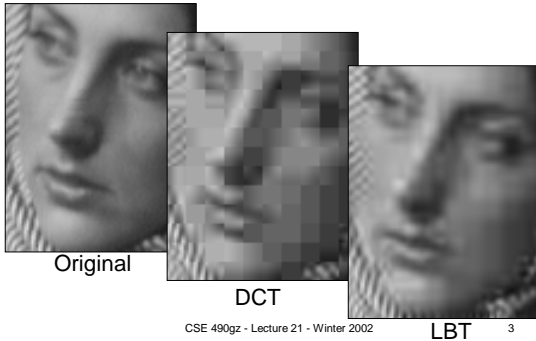
Compression Patents

- Compression has many patents
 - <http://www.faqs.org/faqs/compression-faq/part1/section-7.html>
- There are notable non-patented algorithms
 - gzip is the most famous
- Pros
 - Make money on a good idea
- Cons
 - Many patents are for trivial improvements
 - Patents may impede progress
 - Patents can be ignored or researched

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Lapped Transform Artifacts



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LBT 3

SPIHT Decoding

- The decoder emulates the encoder.
 - The decoder maintains exactly the same data structures as the encoder.
 - When the decoder has popped the Z stack to examine a zero tree it receives a bit telling it whether the tree is significant. The decoder can then do the right thing.
 - If it is significant then it does the decomposition.
 - If it is not significant then it deduces a number of zeros in the current bit plane.

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SPIHT Decoder

k-th iteration
We have list S of significant values and a stack Z of zero trees from the previous pass or the initialization.
Significance Pass.
while Z is not empty do
 T := pop(Z);
 input := read;
 if input = 1 then decompose(T);
 else push T on Z;
 Z := Z'; (At this point all indices in zero trees in Z are insignificant)
Refinement Pass.
for each (i,j) in S do C[i,j,k] := read.

In decompose the signs of coefficients are input

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SPIHT Decoding Example

01111110101110010110100001011000100000010

Initial data structure:

S = (0,0), (0,1), (1,0), (1,1)

Z = (R,0,1), (R,1,0), (R,1,1)

sign(0,0) = - sign(0,1) = +
sign(1,0) = + sign(1,1) = +

	0	1	2	3	4	5	6	7
0								
1								
2								
3								
4								
5								
6								
7								

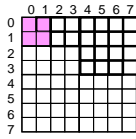
in S

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SPIHT Decoding Example

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in S

$S = (0,0), (0,1), (1,0), (1,1)$

$Z = (R,0,1), (R,1,0), (R,1,1)$

$(R,0,1)$ is significant

$S = (0,0), (0,1), (1,0), (1,1),$
 $(0,2), (0,3), (1,2), (1,3)$

$\text{sign}(0,2) = +$ $\text{sign}(0,3) = +$
 $\text{sign}(1,2) = -$ $\text{sign}(1,3) = +$

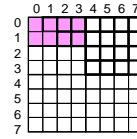
$Z = (RC,0,1), (R,1,0), (R,1,1)$

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SPIHT Decoding Example

01111110101110010110100001011000100000010



in S

$S = (0,0), (0,1), (1,0), (1,1),$
 $(0,2), (0,3), (1,2), (1,3)$

$Z = (RC,0,1), (R,1,0), (R,1,1)$

$(RC,0,1)$ is not significant

$S = (0,0), (0,1), (1,0), (1,1),$
 $(0,2), (0,3), (1,2), (1,3)$

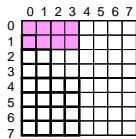
$Z = (R,1,0), (R,1,1)$
 $Z' = (RC,0,1)$

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SPIHT Decoding Example

01111110101110010110100001011000100000010



in S

$S = (0,0), (0,1), (1,0), (1,1),$
 $(0,2), (0,3), (1,2), (1,3)$

$Z = (R,1,0), (R,1,1)$

$Z' = (RC,0,1)$

$(R,1,0)$ is significant

$S = (0,0), (0,1), (1,0), (1,1),$
 $(0,2), (0,3), (1,2), (1,3),$
 $(2,0), (2,1), (3,0), (3,1)$

$\text{sign}(2,0) = +$ $\text{sign}(2,1) = +$
 $\text{sign}(3,0) = -$ $\text{sign}(3,1) = -$

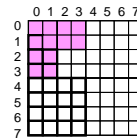
$Z = (RC,1,0), (R,1,1)$
 $Z' = (RC,0,1)$

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SPIHT Decoding Example

01111110101110010110100001011000100000010



in S

$S = (0,0), (0,1), (1,0), (1,1),$
 $(0,2), (0,3), (1,2), (1,3),$
 $(2,0), (2,1), (3,0), (3,1)$

$Z = (RC,1,0), (R,1,1)$

$Z' = (RC,0,1)$

$(RC,1,0)$ is significant

$S = (0,0), (0,1), (1,0), (1,1),$
 $(0,2), (0,3), (1,2), (1,3),$
 $(2,0), (2,1), (3,0), (3,1)$

$Z = (R,2,0), (R,2,1), (R,3,0),$
 $(R,3,1), (R,1,1)$

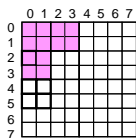
$Z' = (RC,0,1)$

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SPIHT Decoding Example

01111110101110010110100001011000100000010



in S

$S = (0,0), (0,1), (1,0), (1,1),$
 $(0,2), (0,3), (1,2), (1,3),$
 $(2,0), (2,1), (3,0), (3,1)$

$Z = (R,2,0), (R,2,1), (R,3,0),$

$(R,3,1), (R,1,1)$

$Z' = (RC,0,1)$

$(R,2,0)$ is not significant

$S = (0,0), (0,1), (1,0), (1,1),$
 $(0,2), (0,3), (1,2), (1,3),$
 $(2,0), (2,1), (3,0), (3,1)$

$Z = (R,2,1), (R,3,0), (R,3,1), (R,1,1)$

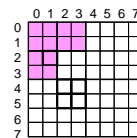
$Z' = (R,2,0), (RC,0,1)$

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SPIHT Decoding Example

01111110101110010110100001011000100000010



in S

$S = (0,0), (0,1), (1,0), (1,1),$
 $(0,2), (0,3), (1,2), (1,3),$
 $(2,0), (2,1), (3,0), (3,1)$

$Z = (R,2,1), (R,3,0), (R,3,1), (R,1,1)$

$Z' = (R,2,0), (RC,0,1)$

$(R,2,1)$ is significant

$S = (0,0), (0,1), (1,0), (1,1),$
 $(0,2), (0,3), (1,2), (1,3),$
 $(2,0), (2,1), (3,0), (3,1),$
 $(4,2), (4,3), (5,2), (5,3)$

$\text{sign}(4,2) = +$ $\text{sign}(4,3) = -$
 $\text{sign}(5,2) = +$ $\text{sign}(5,3) = -$

$Z = (R,3,0), (R,3,1), (R,1,1)$

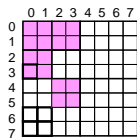
$Z' = (R,2,0), (RC,0,1)$

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SPIHT Decoding Example

01111110101110010110100001011000100000010



■ in S

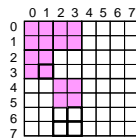
$S = (0,0), (0,1), (1,0), (1,1),$
 $(0,2), (0,3), (1,2), (1,3),$
 $(2,0), (2,1), (3,0), (3,1),$
 $(4,2), (4,3), (5,2), (5,3)$
 $Z = (R,3,0), (R,3,1), (R,1,1)$
 $Z' = (R,2,0), (RC,0,1)$
 $(R,3,0)$ is insignificant
 $S = (0,0), (0,1), (1,0), (1,1),$
 $(0,2), (0,3), (1,2), (1,3),$
 $(2,0), (2,1), (3,0), (3,1),$
 $(4,2), (4,3), (5,2), (5,3)$
 $Z = (R,3,1), (R,1,1)$
 $Z' = (R,3,0), (R,2,0), (RC,0,1)$

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SPIHT Decoding Example

01111110101110010110100001011000100000010



■ in S

$S = (0,0), (0,1), (1,0), (1,1),$
 $(0,2), (0,3), (1,2), (1,3),$
 $(2,0), (2,1), (3,0), (3,1),$
 $(4,2), (4,3), (5,2), (5,3)$
 $Z = (R,3,1), (R,1,1)$
 $Z' = (R,3,0), (R,2,0), (RC,0,1)$

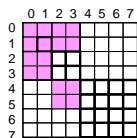
$(R,3,1)$ is insignificant
 $S = (0,0), (0,1), (1,0), (1,1),$
 $(0,2), (0,3), (1,2), (1,3),$
 $(2,0), (2,1), (3,0), (3,1),$
 $(4,2), (4,3), (5,2), (5,3)$
 $Z = (R,1,1)$
 $Z' = (R,3,1), (R,3,0), (R,2,0), (RC,0,1)$

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SPIHT Decoding Example

01111110101110010110100001011000100000010



■ in S

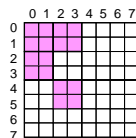
$S = (0,0), (0,1), (1,0), (1,1),$
 $(0,2), (0,3), (1,2), (1,3),$
 $(2,0), (2,1), (3,0), (3,1),$
 $(4,2), (4,3), (5,2), (5,3)$
 $Z = (R,1,1)$
 $Z' = (R,3,1), (R,3,0), (R,2,0), (RC,0,1)$
 $(R,1,1)$ is insignificant
 $S = (0,0), (0,1), (1,0), (1,1),$
 $(0,2), (0,3), (1,2), (1,3),$
 $(2,0), (2,1), (3,0), (3,1),$
 $(4,2), (4,3), (5,2), (5,3)$
 $Z =$
 $Z' = (R,1,1), (R,3,1), (R,3,0),$
 $(R,2,0), (RC,0,1)$

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SPIHT Decoding Example

01111110101110010110100001011000100000010



■ in S

$S = (0,0), (0,1), (1,0), (1,1),$
 $(0,2), (0,3), (1,2), (1,3),$
 $(2,0), (2,1), (3,0), (3,1),$
 $(4,2), (4,3), (5,2), (5,3)$
 $Z = (R,1,1), (R,3,1), (R,3,0),$
 $(R,2,0), (RC,0,1)$

The first bit of each of the members of S are 1011000100000010

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