SPIHT for Generalized Multiple Description Coding

Agnieszka Miguel
Alexander E. Mohr
Eve A. Riskin

University of Washington
amiguel@isdl.ee.washington.edu

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Motivation

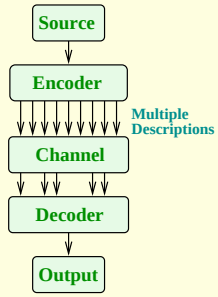
- Computer networks are based on an exchange of packets of data.
- Packets are randomly erased because of congestion.
- Retransmission is often unpractical (delay constraints, lack of feedback channel).

Motivation

- Goal: Obtain graceful degradation of image quality in the presence of packet loss.
- Method: Add controlled amounts of redundancy to each packet.
- Compression Algorithm: Set Partitioning in Hierarchical Trees (SPIHT).
- Framework: Generalized Multiple Description Coding.

Generalized Multiple Description Coding

Goyal, Kovačević and Vetterli'98

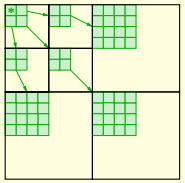


- Goal: Satisfactory image quality when only a subset of descriptions is received.

Set Partitioning in Hierarchical Trees

Said and Pearlman'96

- Wavelet-based, state-of-the-art image coder.
- Progressive coding, embedded bit stream.
- Uses tree-based data structures:



Unequal Loss Protection

- Data that we transmit vary in importance:
  - Low frequency data (coarse structures) are much more important than high frequency data (details).
  - Spatial regions of interest, (areas which are more important to the end user than other regions).
- Protect more important data more heavily than less important data.
- Add unequal amounts of redundancy based on the importance of data.

MD-SPIHT: Algorithm

Packetization (Rogers and Cosman'98):

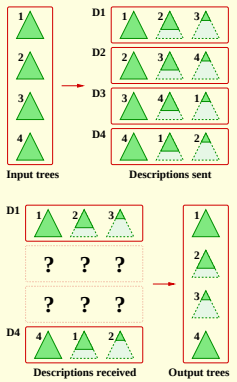
- Code spatially disperse trees in each description.
- Add arithmetic coding.
- Each description has the same bit rate.

Adding Redundancy:

- Place extra copies of each tree in other descriptions.
- Code each copy of a tree at successively lower bit rates.

MD-SPIHT: Algorithm

Coding Example:



MD-SPIHT: Results

5 out of 8 descriptions received (1.25 bpp):

No redundancy added (19.57 dB).

Redundancy added (36.38 dB).

MD-SPIHT: Results

1, 2, 3, and 4 out of 8 descriptions received (1.25 bpp):

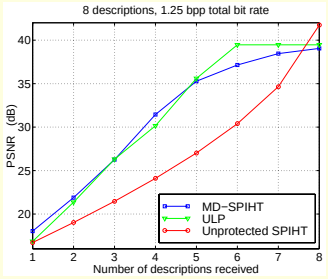
PSNR = 18.21 dB

PSNR = 22.00 dB

PSNR = 27.15 dB

PSNR = 32.04 dB

MD-SPIHT: Results



MD-SPIHT, the Unequal Loss Protection of Mohr *et al.*, and unprotected SPIHT.

Summary

- Simple and efficient scheme for using SPIHT in a Generalized Multiple Description framework.
- Promising results: high image quality is achieved when up to half of the descriptions is lost.
- Can be extended to other compression schemes (wavelet, DCT and VQ-based).
- This work will appear in the Proceedings of the International Conference on Image Processing, 1999.