Introduction to Digital Imaging

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Problems

- Size of images may vary from a few bytes to more than 100 Mbytes
- Allowed storage space
- Time needed for compression and retrieval

Criteria

Range of values - resolution of original,
black and white, gray scale, colour

- Compression to apply is 1 to 1000 times
depends on original and desired quality
- Quality - Lossy or Lossless

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Algorithms

Algorithm	Type	Data	Ratio
RLE	Lossless	Binary images	2 to 3
LZW	Lossless	Text	2 to 3
Huffman	Lossless	Text	2 to 3
Jpeg	Lossy	Still images	5 to 50
Wavelet	Lossy	Still images	2 to 100+
Mpeg	Lossy	Movies	~ 1000 x

Run Length Encoding - RLE

Based on repetitions which are replaced by the value repeated and the number of occurrences:

- to encode   BBBBKCCCCCHAAAAAA4
- encoded   @4BK@5CH@6A4
- lossless
- used in the medical industry

Lempel, Ziv, Welch - LZW

Dictionary based system

- builds a dictionary of input data in order to avoid repetitions. Patterns of data are replaced by codes

- the most widely used algorithm - PKZIP

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Joint Photographers Expert Group - JPEG

Still image compression

- achieves compression by deleting some of the high frequencies in an image
- used on the Web and by NASA for satellite Earth surveys
- several algorithms lossless and lossy
- typical compression 10 to 50x
- JPEG breaks down after approx. 80x compression
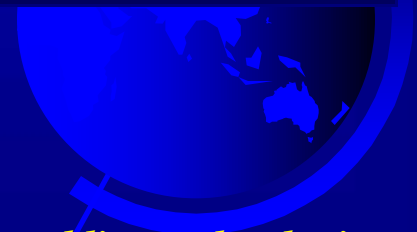
Wavelets

The best algorithm available

- Progressive encoding, images can be visualised at different resolutions

- Wavelets are mathematical functions: they cut up data into different frequency components, each of which is then studied with a resolution matched to its scale

- many types of Wavelets - no standard yet

Compression Ratio 190 : 1

JPEG
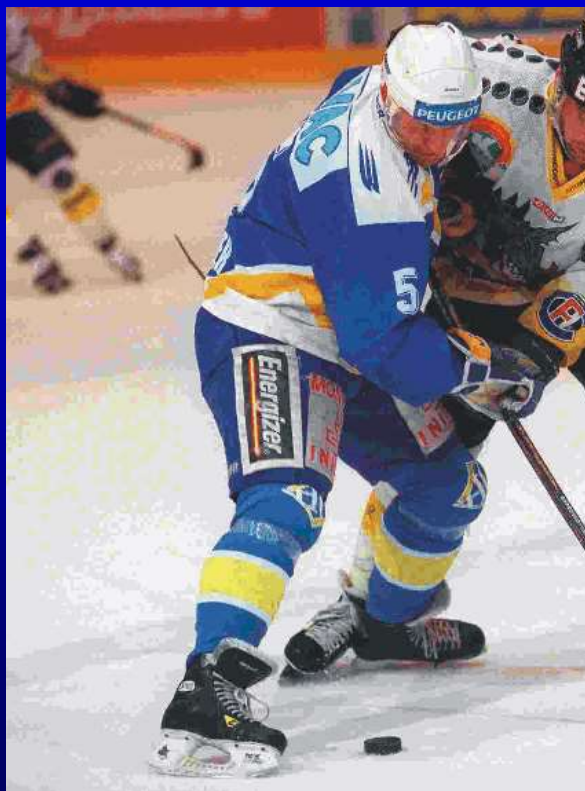
Wavelet Image

Compression Ratio 337:1

JPEG

Wavelet Image

Compression Ratio 330:1

JPEG

Wavelet Image

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Compression Ratio 396 : 1

JPEG

Wavelet Image

JPEG versus Wavelet

JPEG
- looses many colours and falsifies the remaining colours
- significant decrease in contrast
- significant decrease in colour saturation

Wavelet
- does not loose significant amount of colours
- contrast of the original is maintained
- colour saturation of original is maintained

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JPEG 2000

- Wavelet based

- Progressive multi-resolution decompression

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Uses for Image Compression

Almost everybody:

- Banks - signatures, personnel photos, brochures
- Museums
- News agencies
- Hospitals
- Sporting events
- Documentaries
- Internet
- Anyone or company requiring massive photographic archives

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Moving Pictures Experts Group - MPEG

Video

- Several versions - Mpeg1 for normal TV
  Mpeg2 the TV/DVD format
  Mpeg4 for computer video

- Takes more time to compress than to decompress

- Decompression must be in real-time

- Requires relatively fast computers

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Converting Movies to a Digital Format

Video source must be highest quality possible

- BetaCam SP was the preferred format for its quality and precision at the time

- VHS and Super VHS are generally not good enough

- different formats must be considered: 4:3
                                                                    16:9
                                                                    2.35:1

- custom formats: Internet and Reuters Business TV

Uses for Video compression

For almost everything

- Banks, Education, Publicity, Surveillance
- Museums
- New agencies
- Hospitals
- Documentaries
- Movies
- Leisure
- Sporting events
- Surveillance in parking, public areas
- All forms of education, schooling
- Internet
- Anyone or company requiring video archives

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