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# Overview of Encoding for the Web

## Part II

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# A Look at Codecs

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## Why Use Codecs?

- Codecs are necessary because raw video is so large
  - 1 second of uncompressed NTSC video = 27MB of disk space
- Codecs work to reduce file size by removing:
  - redundant video and audio data
  - non-redundant but less important data, resulting in image/sound degradation

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## Overview of Codecs

- All codecs do the same thing
- Code:
  - take incoming video stream
  - compress the signal
  - transmit the smaller file
- Decode:
  - decompress the signal
  - display on a monitor or T V

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## Overview of Codecs

- Codecs are “lossy”
  - Some data is lost in the translation from the original numbers to the smaller, encoded number set
  - Some data lost in the translation back to the larger decoded number set
  - Quality of encoder = how little is lost and how little you can tell anything has been done to the file

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## Overview of Codecs

- Codecs main issue is speed:
  - They have to compress mountains more data in the same time it takes smaller forms of stored data to compress
    - jpeg vs. sorenson
  - Most processors today are fast enough to decompress video without needing a special video card

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## Overview of Codecs

- Codecs are installed with the player you choose to use
- To get other codecs, contact specific content provider or company

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## Two Kinds of Codecs

- Spatial Encoding
- Temporal Encoding
- <http://www.icanstream.tv/CodecCentral/Architectures/QuickTime.html>
- <http://www.siggraph.org/education/materials/HyperGraph/video/architectures/QuickTime.html>
- <http://www.siggraph.org/education/materials/HyperGraph/video/codecs/Default.htm>

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## Spatial Encoding

- How does it work?
  - Simplest method replaces actual pixel data with a code for that data
    - uses “redundancy” or repetition of same element
    - for each pixel, checks to see if next pixel is the same color or if there’s a series of the same color
    - replaces the first pixel with a code that describes it and its “twins”
    - looks for repeating patterns to repeat the code
    - if finds related patterns, creates related code and repeats it where possible

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## Spatial Encoding

- How does it work?
  - More complex methods replace whole segments of an image with number sets that represent the image in “transformed” state
  - Transformation can be achieved by replacing pixel position info with pixel frequency info
    - pixel at row 3, column 4 = red
    - every third pixel = red
  - Major example of this is Discreet Cosine Transformation (DCT)

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## Spatial Encoding

- Discreet Cosine Transformation (DCT)
  - Basis of most commercial encoding technologies today
  - How it works
    - Square regions of 64 pixels (8 rows x 8 columns) transformed into a sequence of 64 “coefficients” which are then related to a frequency analysis of the region
    - Lower numbered coefficients correspond to low frequencies (slow changes in color or brightness)
    - Higher numbered coefficients correspond to high frequencies (fast changes in color or brightness)

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## Spatial Encoding

- Discreet Cosine Transformation (DCT)
  - According to research, most relevant info in an image exists in lower 25% of these coefficients
  - Higher coefficient areas (high frequency information) are less important to portray accurately due to recognition of info mattering more to the eye in low frequency areas
  - Therefore, often possible to set high coefficient areas to 0, resulting in very significant compression of data
  - There is another important spatial transform tool: Wavelet technology

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## Spatial Encoding

- Block discrete cosine transform: image data transformed from spatial domain to frequency domain.

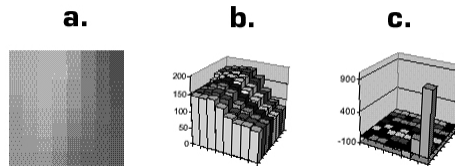


Figure 2. Block of image data (a , b) transformed to DCT coefficients (c).

- (a) image block
- (b) image block with luma represented as height
- (c) DCT coefficients. The dc term is in the front corner.

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## Spatial Encoding

- Wavelet Technology
  - Newer than DCT
  - Some advantages over DCT
  - Require much more computational power to achieve same results as DCT
  - [http://www.cdt.luth.se/~johnny/mediatech/courses/met002/2000/lectures/2000oct05mathiasj/luth\\_pres.pdf](http://www.cdt.luth.se/~johnny/mediatech/courses/met002/2000/lectures/2000oct05mathiasj/luth_pres.pdf)

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## Scalability

- MPEG-2 encoding offers “scalable extensions”
  - permit division of a continuous video signal into two or more coded bitstreams
  - can represent the video in three “flavors”:
    - spatial scalability = different resolutions
    - temporal scalability = different frame rates
    - SNR scalability and data partitioning = different picture quality

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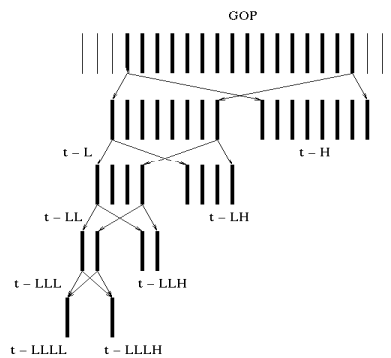
## Combinations: What's Going on in the Field

- Quote from a paper on an encoding experiment:
  - “The following section gives a high-level overview over some of the proposals that were brought to the 60<sup>th</sup> MPEG meeting in Fairfax.
  - **3.1 Motion Compensated Embedded Zero Block Context coder**
  - MC-EZBC is a video coder using a 3-D subband/wavelet transform along motion trajectories, followed by a highly embedded and scalable spatial coder.”

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## Combinations: What's Going on in the Field

Diagram of "MC-EZBC" currently in development



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## How to Get in the Game

- To download a freeware MPEG encoder
- <http://www.mnsi.net/~jschlic1/>
- A guy who wants to share:
  - "Did you buy a CD burning package with the intention of making VideoCD's, only to find out when you got it home that it doesn't come with an encoder to turn your avi files into mpeg files so you can actually make VideoCD's? Then avi2vcd is what you need."

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## Windows Media

- Supports realtime streaming with Windows Media Server
  - bundled with Windows 2000 and NT servers

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## Windows Media

- Intelligent Streaming
  - Windows Media's answer to Real's SureStream feature
    - must have Windows Media Server to utilize IS
  - Scalability
    - uses up to 5 alternate video streams and 1 audio
      - same audio for all 5 versions
      - employs a range of connection speeds
      - on Mac can do only 1 video and 1 audio

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## Windows Media

- Download is only option w/HTTP servers
- Can encode audio separately
- Available codecs
  - Windows Media Video
    - proprietary, recommended by Cleaner, need fast computer
  - MPEG-4
    - good for Win 95/NT and Mac users
    - Use MPEG-4 v.3 for best results, v2 for backwards compatibility

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## Windows Media

- Download is only option with HTTP servers
- However, can configure for

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## Capture Card Comparison

- Informative article about DV capture issues and comparison tables of cards listed alphabetically
- <http://www.computertracker.com/2001/7-Aug/page20.html>

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## DV Type I vs. Type II

- On Windows, DV is a form of AVI
  - There are two kinds of DV AVI formats
  - Type I is simplest and smallest, but also least compatible with editors and other files.
  - Type II is larger (5%) and more complex, but also easiest for other programs to read

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## DV Type I vs. Type II

- Informative article about DV Type I and Type II avi formats
- Great diagrams of the differences between the two related formats
- <http://www.puremotion.com/editstudio/manual/videoediting/dvfiletypes/>

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## AVI 1.0 vs. AVI 2.0

- AVIs come in two flavors also:
  - AVI 1.0
  - AVI 2.0
    - The two are not compatible
    - They aren't related to DV Type 1 or 2

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## AVI 1.0 vs. AVI 2.0

- AVIs come in two flavors also:
  - AVI 1.0 = Standard AVIs
    - have size maximum of 2GB
    - Due to internal storage of info as 32 bit numbers
  - Video for Windows can finesse it to 4GB with careful programming in some apps

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## Why MSFT is ditching Video for Windows

- AVI 2.0
  - Stores info internally as 64 bit numbers
  - theoretically, enables size maximum of 18,000,000,000GB
  - Implemented in Windows DirectShow, which replaces Video for Windows
  - Only works with programs that can create 4GB or larger files
    - NT, 2000, and XP
    - Irrespective of the AVI file format, Windows 95, 98 and ME are limited to maximum file sizes of 4 GB