

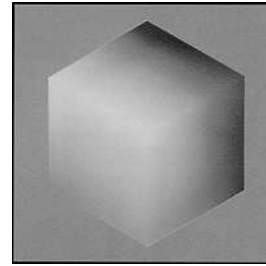
Outline

- Introduction
 - Lossless compression
 - Lossy compression
 - metrics
 - general methods
 - scalar
 - vector
 - differential
 - transform (JPEG)
 - subband (wavelet)
- ➔ – MPEG video



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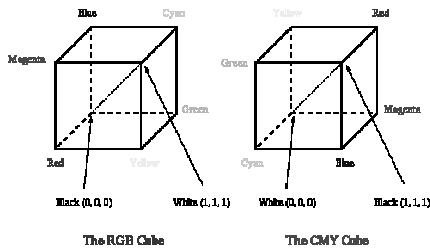
RGB Color Model for CRT Displays



R,G,B integer triplets encode how much the corresponding phosphor should be excited in devices such as a CRT display.

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RGB vs CMY



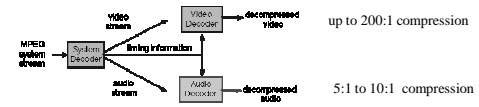
- CMY are complementary colors of RGB
- CMY mostly used in printing devices where color pigments on the paper absorb certain colors (eg. no red light reflected from cyan ink)

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Video Coding



- MPEG - Motion Pictures Expert Group, 1988
 - asymmetric application
 - single compression; frequent decompression
 - compression is complex!!
 - standards consist of 3 parts:

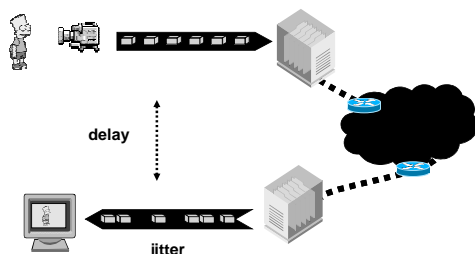


- similar to IUT-T H.261 videoconferencing standard

Thanks to Prof. Leonardo Chiariglione for MPEG slide material.

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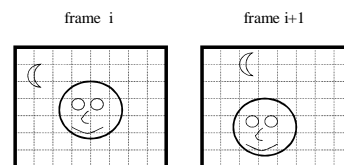
Video Flow : Delay vs. Jitter



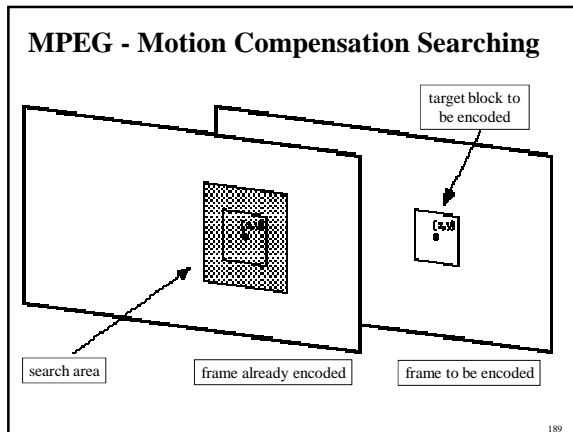
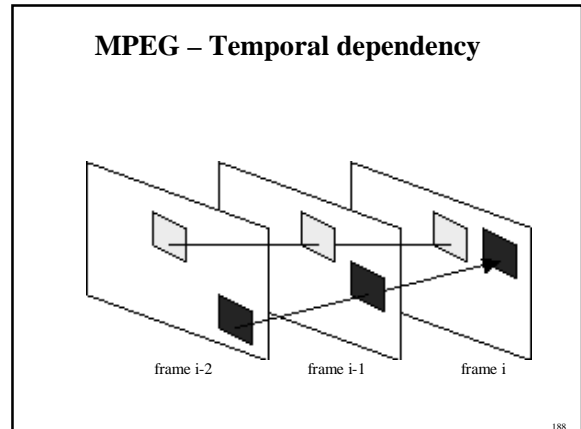
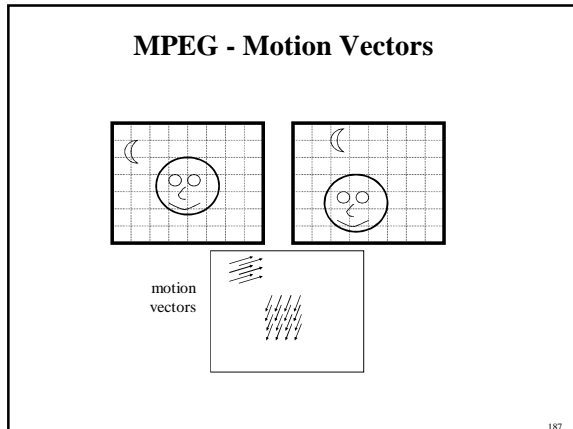
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MPEG

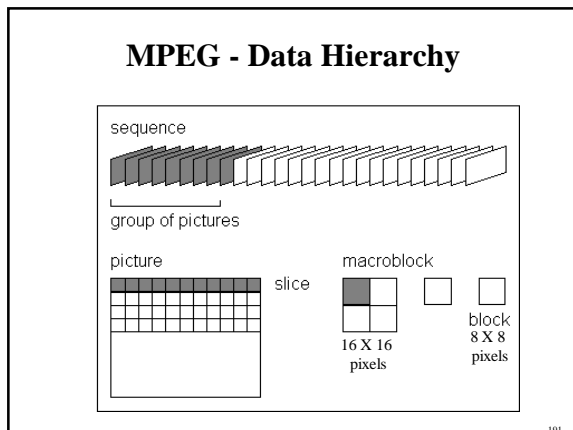
- key compression idea: temporal prediction



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- ### MPEG - Motion Compensation Searching
- tradeoff: target block size
 - larger blocks are harder to match
 - larger blocks, if matched well, compress more
 - tradeoff: search area size
 - larger areas require more computation to search
 - larger areas may find better matches; hence more compression
 - motion vector (x,y)
 - (15,4) - 15 pixels right, 4 pixels up
 - can be in units of 1/2 pixel
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MPEG - Metrics

- Matching Criteria - Metrics to measure differences between blocks
- mean absolute difference

$$\frac{1}{mn} \sum_{p=1}^m \sum_{q=1}^n |A[p,q] - B[p,q]|$$
- mean square difference

$$\frac{1}{mn} \sum_{p=1}^m \sum_{q=1}^n (A[p,q] - B[p,q])^2$$
- PDC - pel difference classification

$$\sum_{q=1}^m \sum_{p=1}^n [ord(|A[p,q] - B[p,q]| \leq t)]$$

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MPEG Motion Compensation - Search Algorithms

- “coarse quantization” or “distance-diluted”

hypothesis: fast moving objects look blurred to HVS even if sharp in all frames

○ = center of potential matching block

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MPEG Motion Compensation - Search Algorithms

- “locality-based” or “multi-level hierarchical”

hypothesis: once a close match is found, even better ones are nearby

- First hierarchical level
- Best match at the first level
- Second hierarchical level

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MPEG Block-Based Motion Compensation

GOP - Group of Pictures

- I frame - Independent encoding
- P frame - Predictive encoding based on most recent past I or P
- B frame - Bidirectional encoding based on past and future I or P

(Each frame is encoded as a series of 16 x 16 pixel macroblocks)

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Inter-frame (P-frame) Coding

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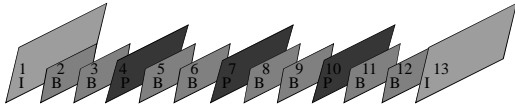
B frame encoding

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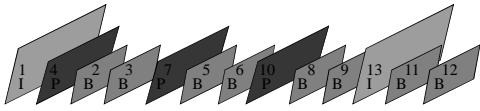
GOP - Group of Pictures

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Display vs Transmission Order



display order



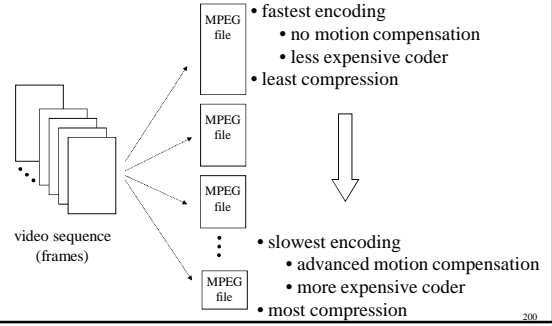
transmission order

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MPEG Decode-ability

MPEG is uniquely decodable

MPEG is NOT uniquely codable



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