

Digital movie encoding

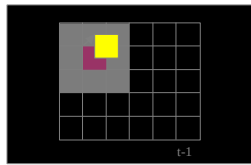
C306
Lecture 29
Martin Jagersand

Digital movie encoding

- Encode time sequences of frames
- Movie compression also based on transform coding like jpeg
- Strong temporal correlation between frames
- Introduces motion-compensated prediction (hybrid coding)
- Predict a frame based on a past frame

Block Matching Techniques

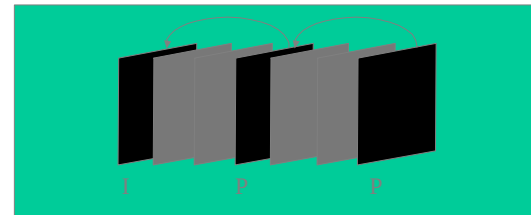
- Full search (most used)



- Others
 - Three-step
 - 2-D logarithmic
 - Conjugate directions

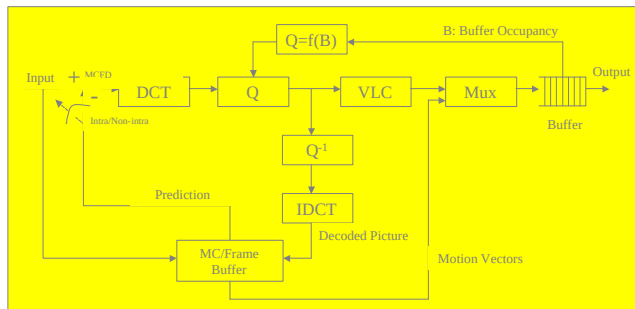
Picture Structure

- Intra (I) vs. Predicted (P) Pictures



- I and P macroblocks

H.261 Codec Structure



MPEG Video Coding

- MPEG-1 vs. H.261
 - Higher bitrates ($\sim 1.41 \text{ Mbps} = 1\text{X CD-ROM}$)
 - Slice structure
 - B pictures
- MPEG-2 vs. MPEG-1
 - Standard TV and High-Definition TV resolution
 - Interlacing (field/frame coding)
 - Higher bitrates ($> 20 \text{ Mbps}$)
 - Scalability

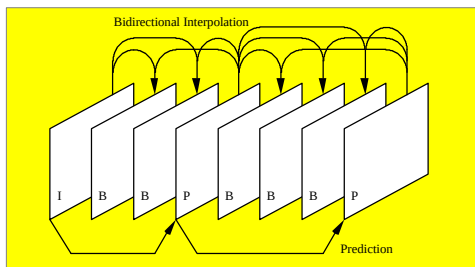
- # MPEG Video Coding
- MPEG-1 vs. H.261
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Bidirectional Interpolation

- B Pictures

The diagram shows a sequence of eight video frames represented as white rectangles on a yellow background. The frames are labeled from left to right as I, B, B, P, B, B, B, and P. Above the frames, the text 'Bidirectional Interpolation' is written. Curved arrows indicate the interpolation process: from the first frame (I) to the second (B), from the third (B) to the fourth (P), from the fifth (B) to the sixth (B), from the seventh (B) to the eighth (P), and from the fourth (P) to the sixth (B). Below the frames, a 'Prediction' label with an arrow points to the fourth frame (P), indicating its role as a reference for the subsequent frames.

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- B Pictures
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Bidirectional Interpolation/2

- Display vs. coding order

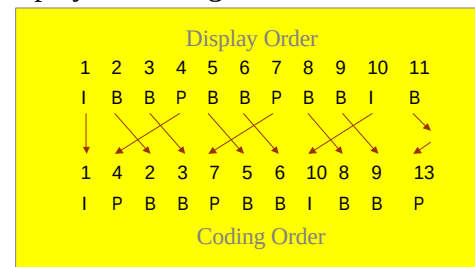
Display Order

1	2	3	4	5	6	7	8	9	10	11
I	B	B	P	B	B	P	B	B	I	B

Coding Order

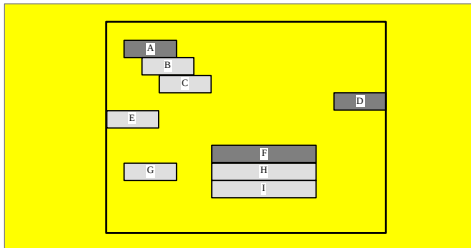
1	4	2	3	7	5	6	10	8	9	13
I	P	B	B	P	B	B	I	B	B	P

- ## Bidirectional Interpolation/2
- Display vs. coding order
-
- Display Order
- | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|----|----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| I | B | B | P | B | B | P | B | B | I | B |
- Coding Order
- | | | | | | | | | | | |
|---|---|---|---|---|---|---|----|---|---|----|
| 1 | 4 | 2 | 3 | 7 | 5 | 6 | 10 | 8 | 9 | 13 |
| I | P | B | B | P | B | B | I | B | B | P |

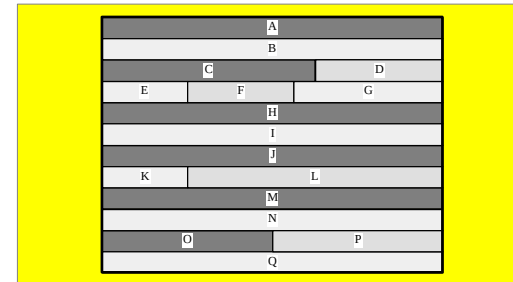


General Slice Structure

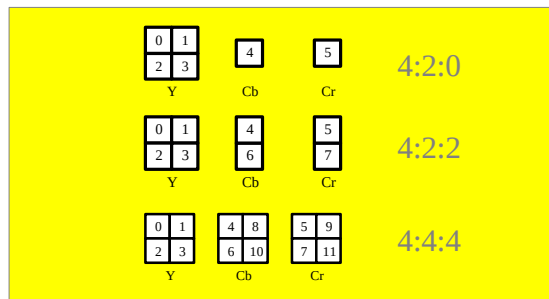
- Decoder behavior in uncovered areas is undefined



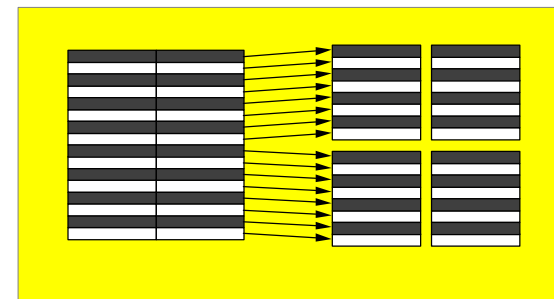
Restricted Slice Structure



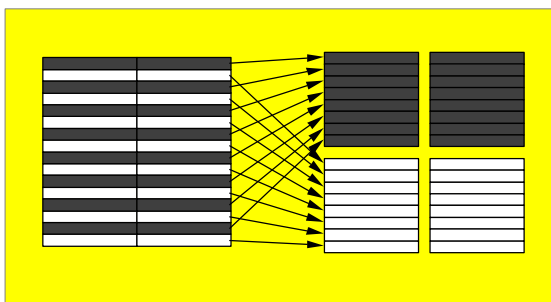
Macroblock Structure



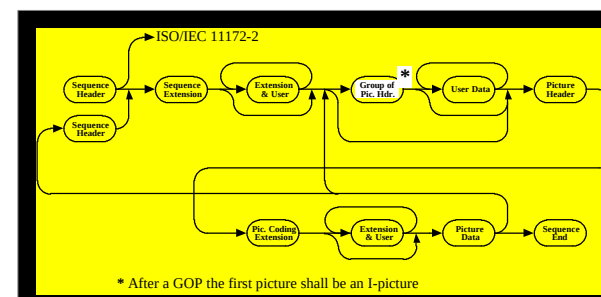
Frame DCT Coding



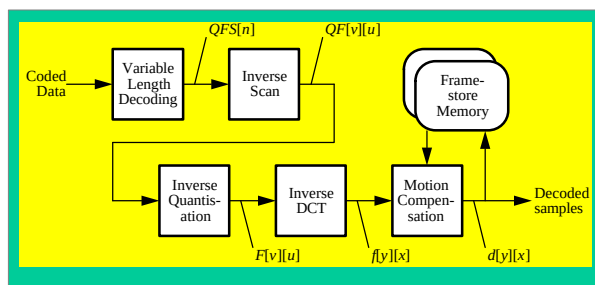
Field DCT Coding



Syntax Overview



Simplified Video Decoding Process



MPEG - The basic tenets

- Stick to the deadline
- A-priori standardisation
- Not systems but tools
- Specify the minimum
- One functionality - one tool
- Relocation of tools
- Verification of standard

MPEG-1: The first step/1

- Target:
 - Storage of Moving Pictures on CD
 - Net bitrate of CD: ~1.41 Mbit/s
- Background:
 - the ITU-T H.261 videophone standard at px64 kbit/s ($p=1,\dots,30$)
 - CD-I, DVI
- New freedom: causality not required!

MPEG-1: The first step/2

- Design parameters
 - Video component:
 - input: 288x352@25Hz or 240x352@30 Hz
 - output: 1.15 Mbit/s
 - Audio component:
 - input: stereo pair @48kHz sampling 16 bit/sample
 - output: 256 kbit/s
- Achieved performance
 - Video: similar to VHS
 - Audio: virtual transparency

MPEG-1: the standard structure

- MPEG-1 (ISO/IEC 11172) is a 5-part standard
 - Systems
 - Video
 - Audio
 - Conformance Testing
 - Reference software

MPEG-1: an assessment

- MPEG-1 (ISO/IEC 11172)
 - has created the new industry of Video CD (2 million players sold)
 - is being used for DAB in Europe/Canada
 - is the standard file format on the Internet
 - some VGA cards mount an MPEG-1 decoder
 - Microsoft's ActiveMovie 1.0 includes MPEG-1
 - MPEG-1 software decoding possible on high-end PC today