



Special Module on Media Processing and Communication

Dayalbagh Educational Institute
(DEI)
Dayalbagh Agra

CSM 011

Indian Institute of Technology Delhi
(IITD)
New Delhi

SIV 864



Video Compression (Recap)

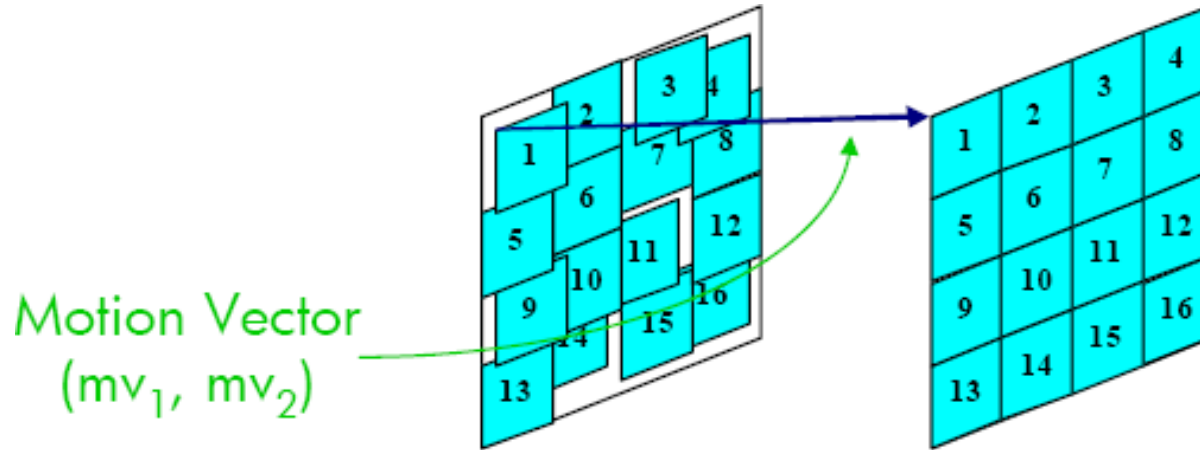
Intuitive Methods

- Subsampling
Drop frames
- Differencing
Differential coding of pixels
- Block Differencing
Differential coding of blocks (big pixels)
- Motion Compensation
Figure out the motion vector and compensate for it



Video Compression

Motion Estimation





Video Compression

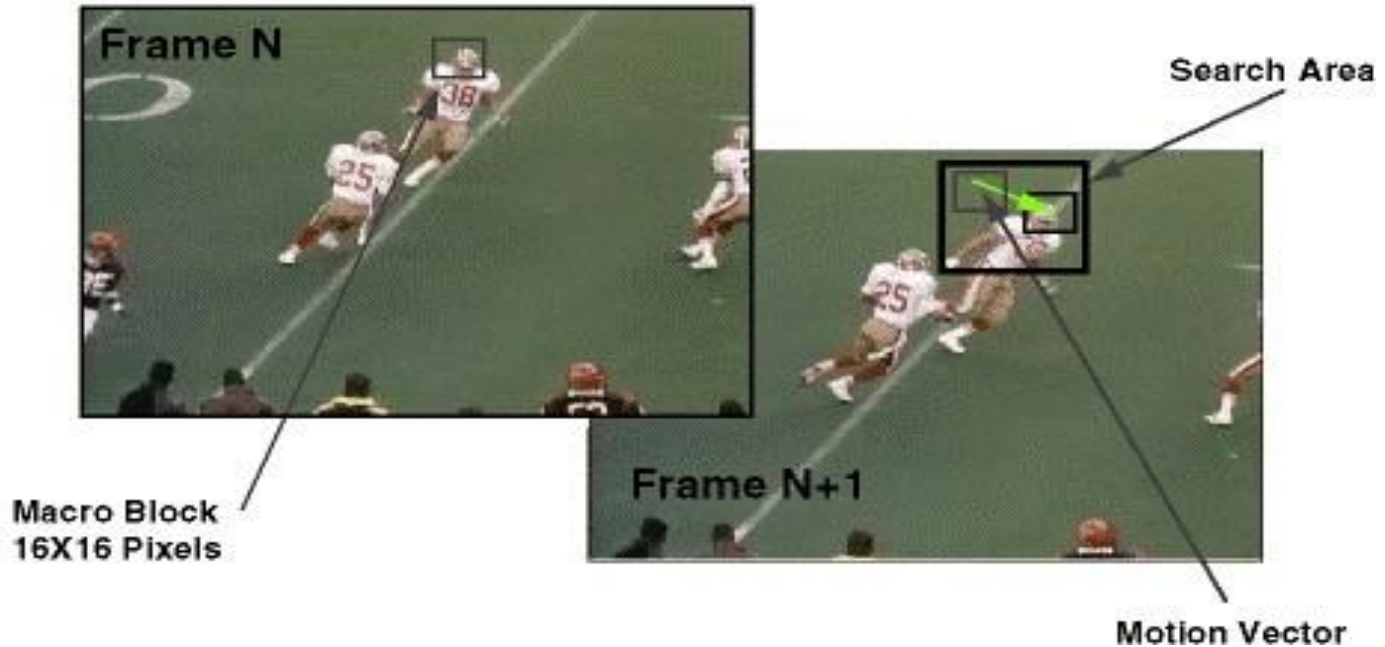
Motion Estimation

- Translation motion model
- All pixels within the block have the same motion
- Motion is estimated using only luminance
- The motion vector is encoded in place of the target block itself.
- Fewer bits are required to code a motion vector



Video Compression

Motion Compensation





Video Compression

Motion Estimation

Issues:

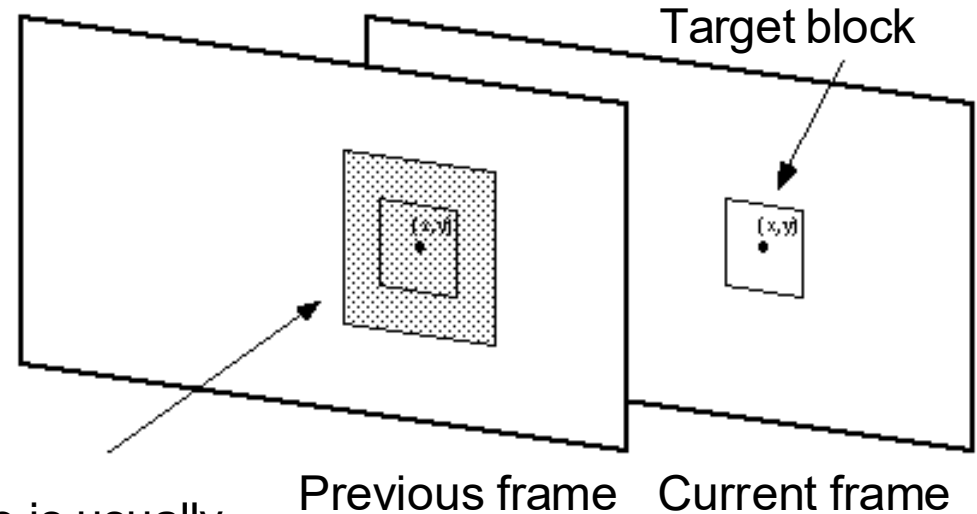
Block size ?

Search range ?

Motion vector accuracy ?

Complex motion ?

Search area in previous frame is usually limited to a region close to the target block





Video Compression

Best Match

Sum of Squared Distance

$$SSD = \sum_{i=0}^{N-1} (x_i - y_i)^2$$

Sum of Absolute Distance

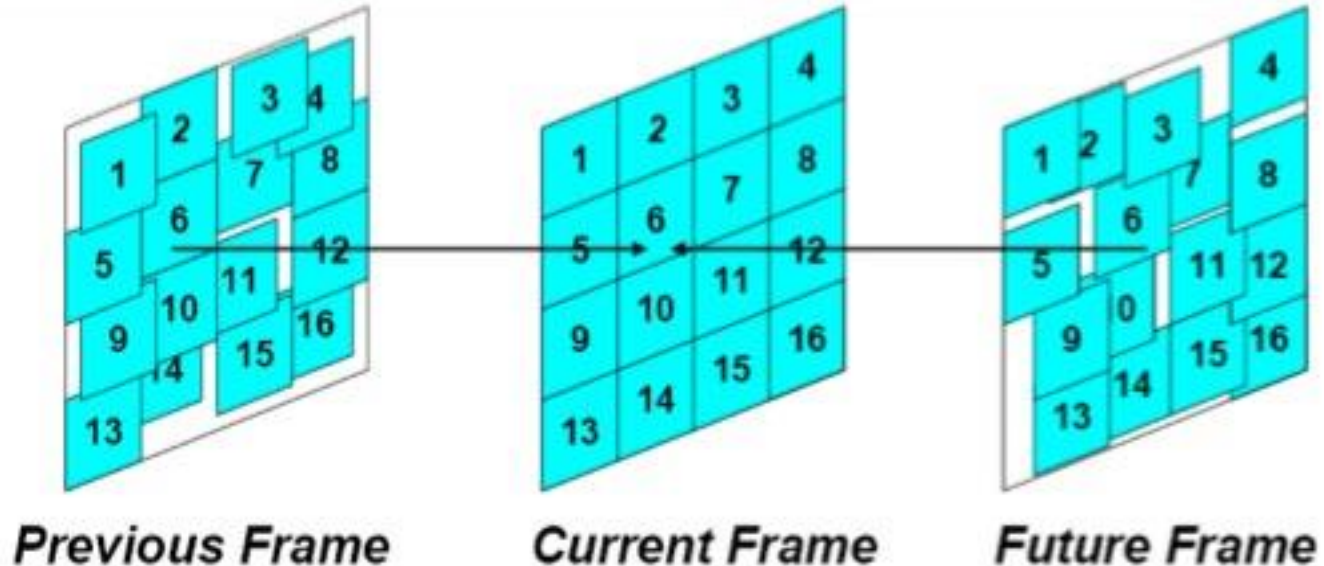
$$SAD = \sum_{i=0}^{N-1} |x_i - y_i|$$



Video Compression

Motion Estimation

Forward, Backward, Bidirectional

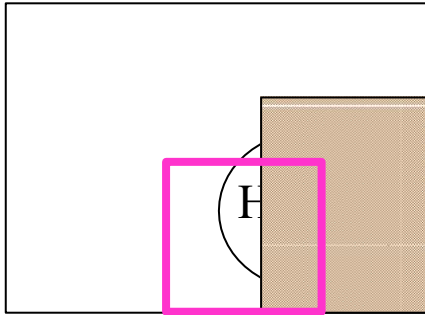




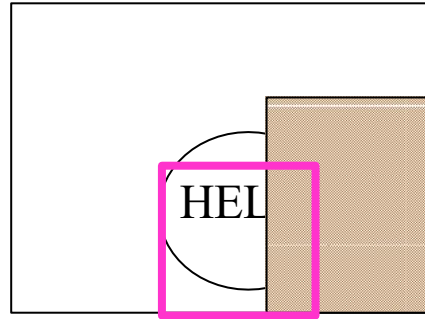
Video Compression

Motion Estimation

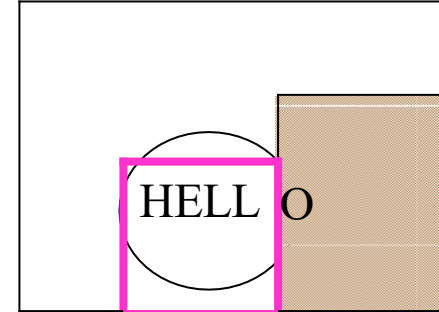
Example



Frame N-1



Frame N



Frame N+1



Video Compression

Motion Estimation

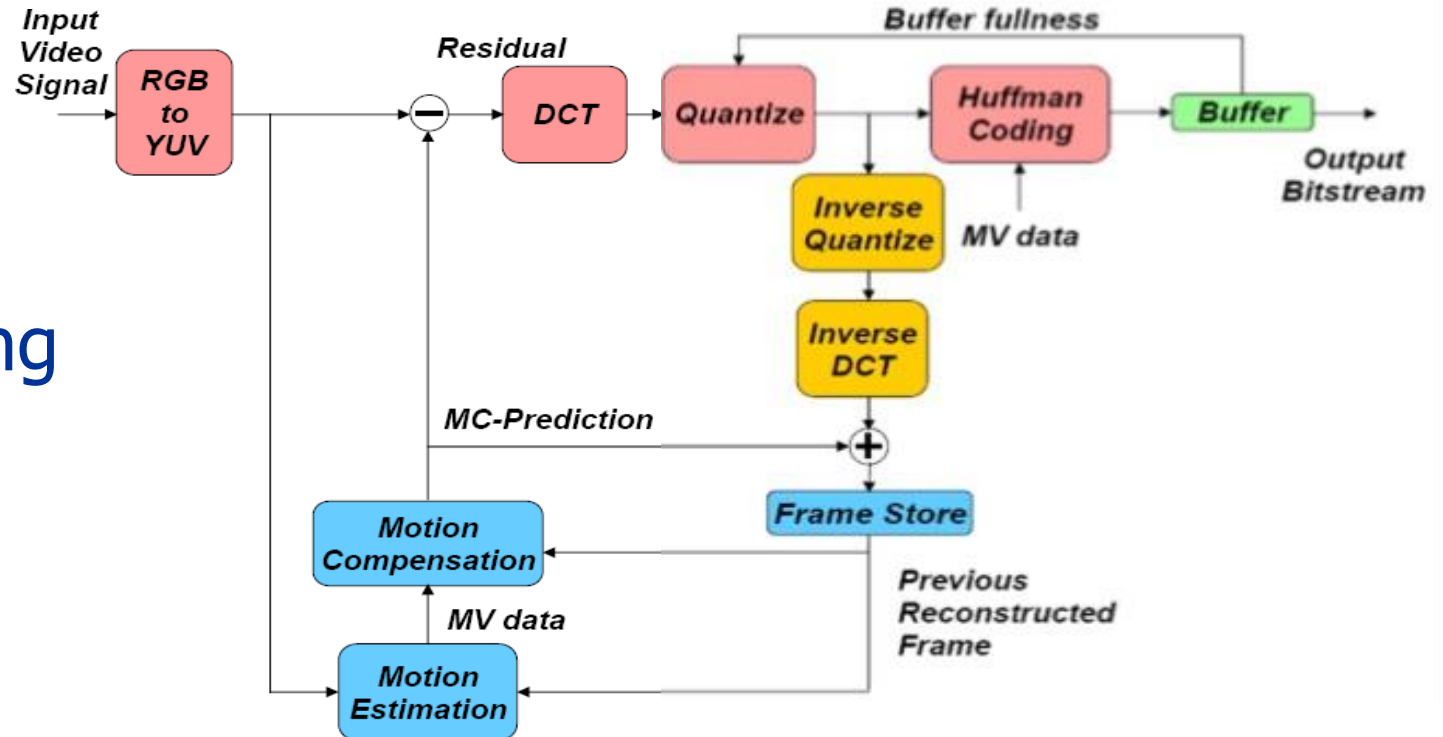
As a general scheme a block in current frame can be estimated from a block in

- Previous frame
- Future frame
- Average of a block from the previous frame and a block from the future frame
- Neither (no prediction)



Video Compression

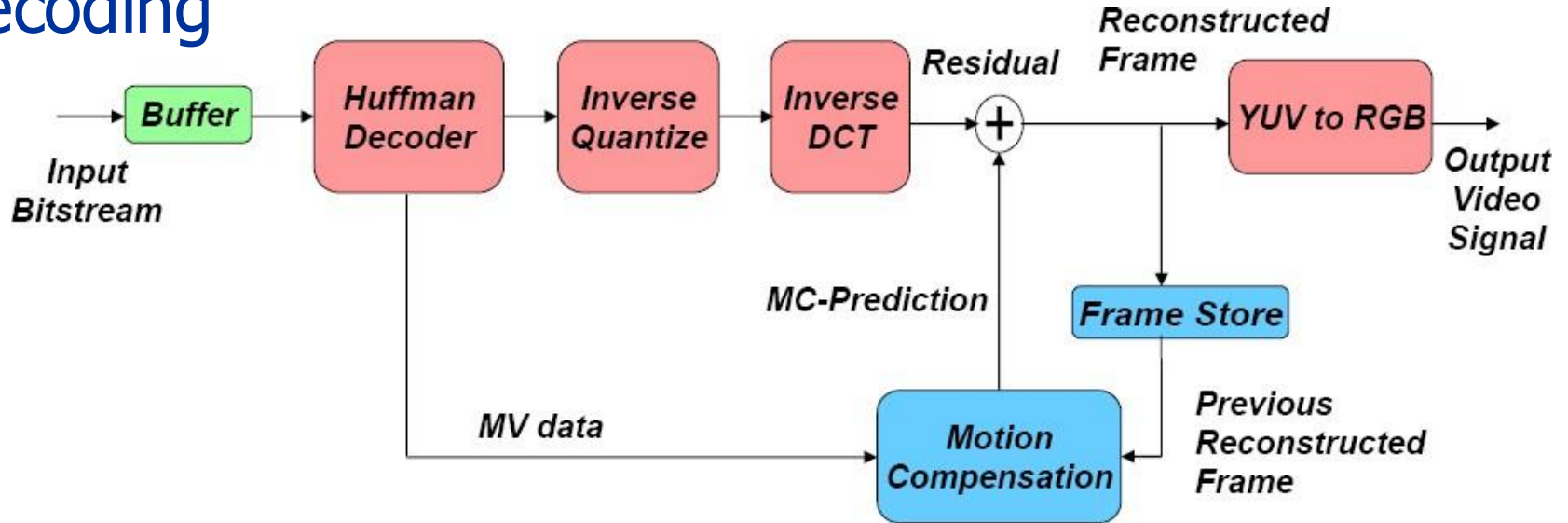
Encoding





Video Compression

Decoding





Video Compression

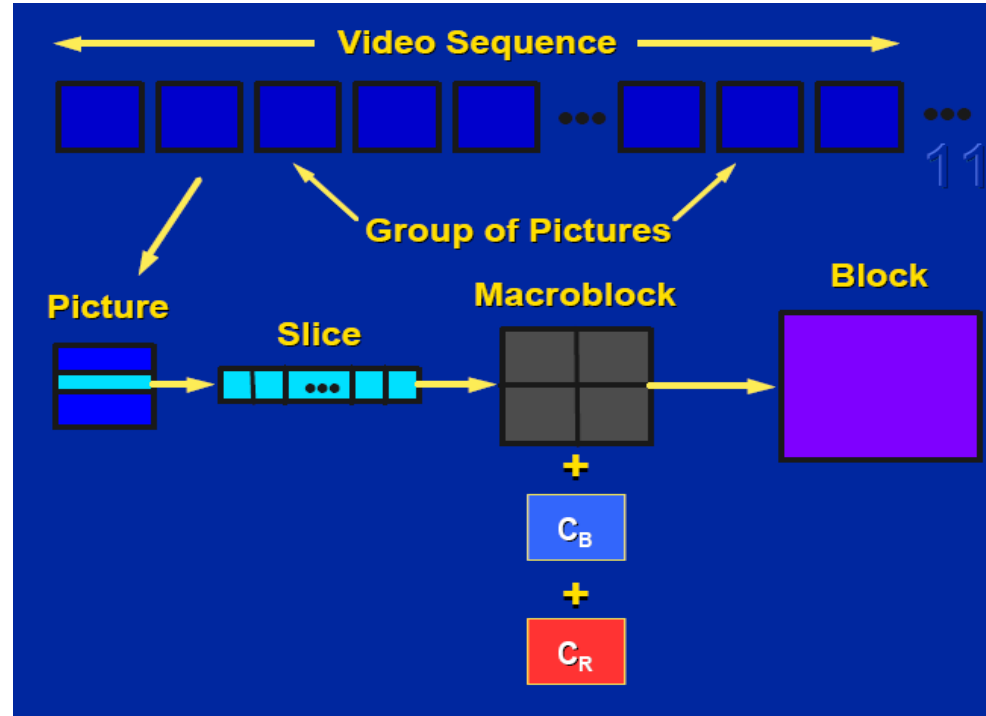
MPEG Standard

- **Block**: A basic unit for DCT operation (8x8)
- **Macroblock**: A basic unit for motion compensation operation (16x16)
- **Slice**: String of macroblocks
- **Picture/Frame**: I/B/P
- **Group-of-pictures (GOP)**: Collection of pictures (10 or so)
- **Video**: Global context unit



Video Compression

MPEG Standard





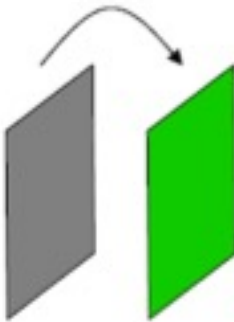
Video Compression

Three types of coded frames

- I-frame: Intra coded frame, coded independently
- P-frame: Predictive coded frame, coded based on previously coded frame
- B-frame: Bi-directionally predicted frame, coded based on previous and future coded frames



I-frame



P-frame

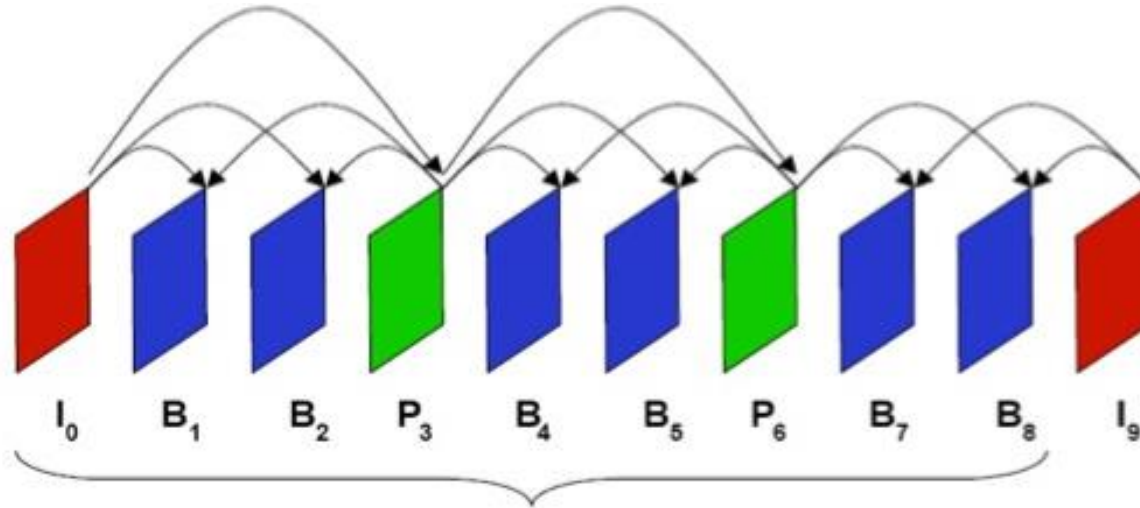


B-frame



Video Compression

Three types of coded frames



MPEG GOP

Display order: $I_0, B_1, B_2, P_3, B_4, B_5, P_6, B_7, B_8, I_9$

Transmission Order: $I_0, P_3, B_1, B_2, P_6, B_4, B_5, I_9, B_7, B_8$