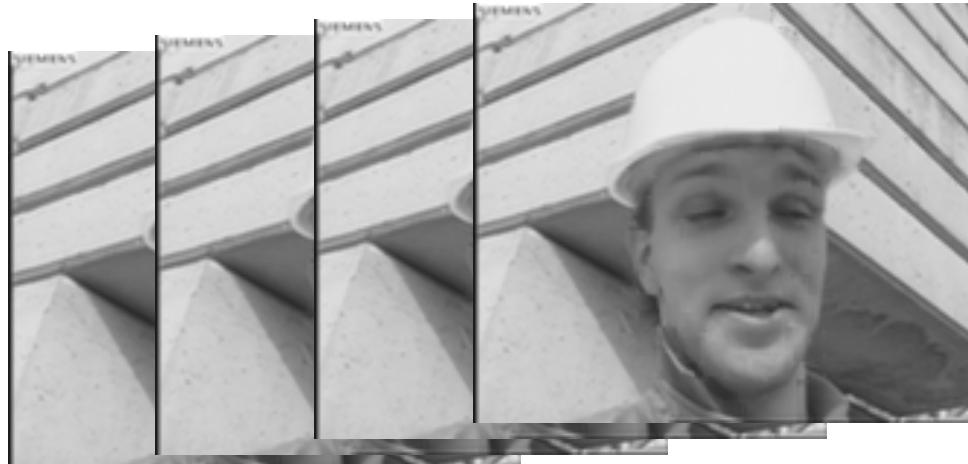


Video Coding Everywhere ...

- Digital television broadcasting (DVB)
- Digital theater projection
- Digital video/versatile disk (DVD)
- Personal video recorder (PVR)
- Web-based streaming
- Video conferencing
- Mobile video
- ...



Motivation for Compression



frame size 1280x960
bit-depth 12 bpp
frame rate 30 fps

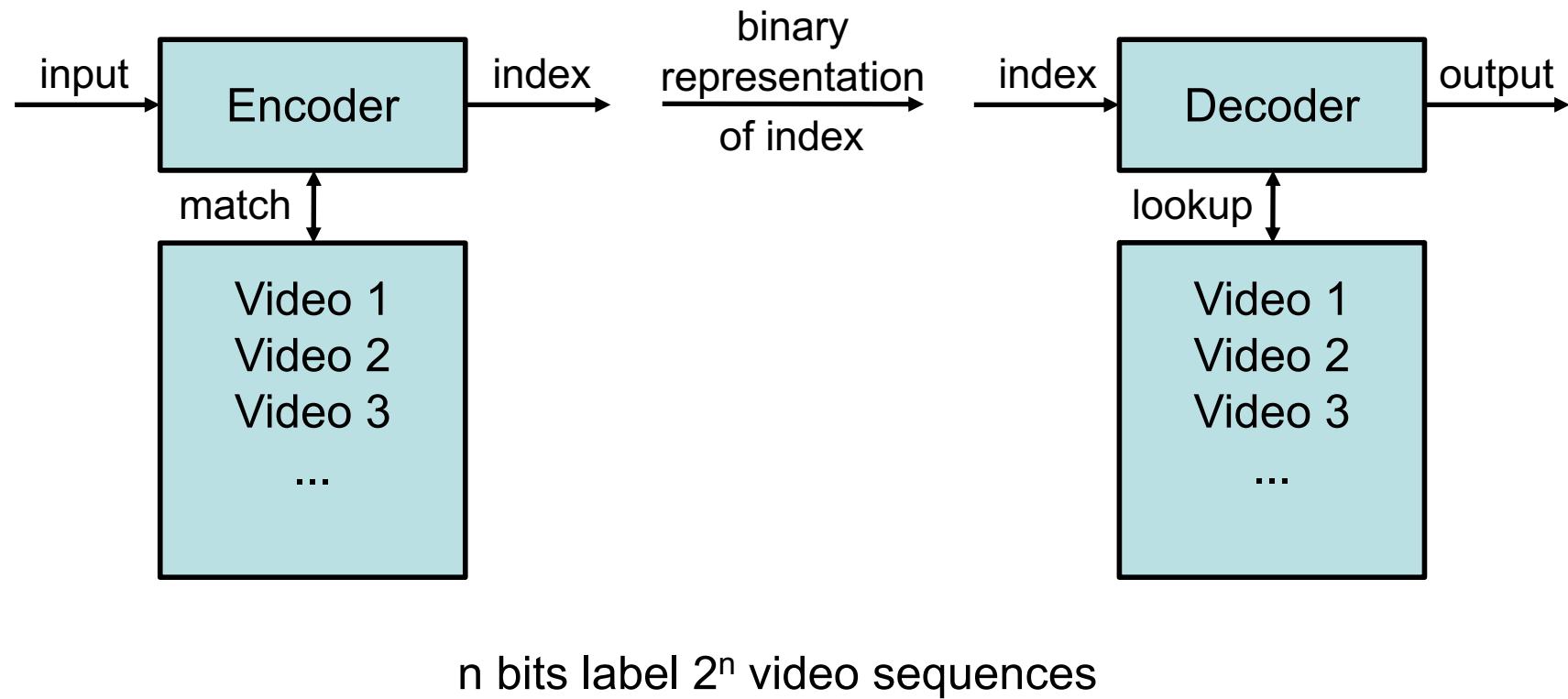
uncompressed data rate:
442 Mbps

Some interesting bit-rates

- | | |
|---------------------------------------|-------------------|
| — Terrestrial TV broadcasting channel | ~20 Mbps |
| — DVD (4.7...17 GB/length of movie) | 5...20 Mbps |
| — Ethernet/Fast Ethernet | <10/100/1000 Mbps |
| — DSL downlink | 1...10 Mbps |
| — Mobile broadband | 1...7.2 Mbps |



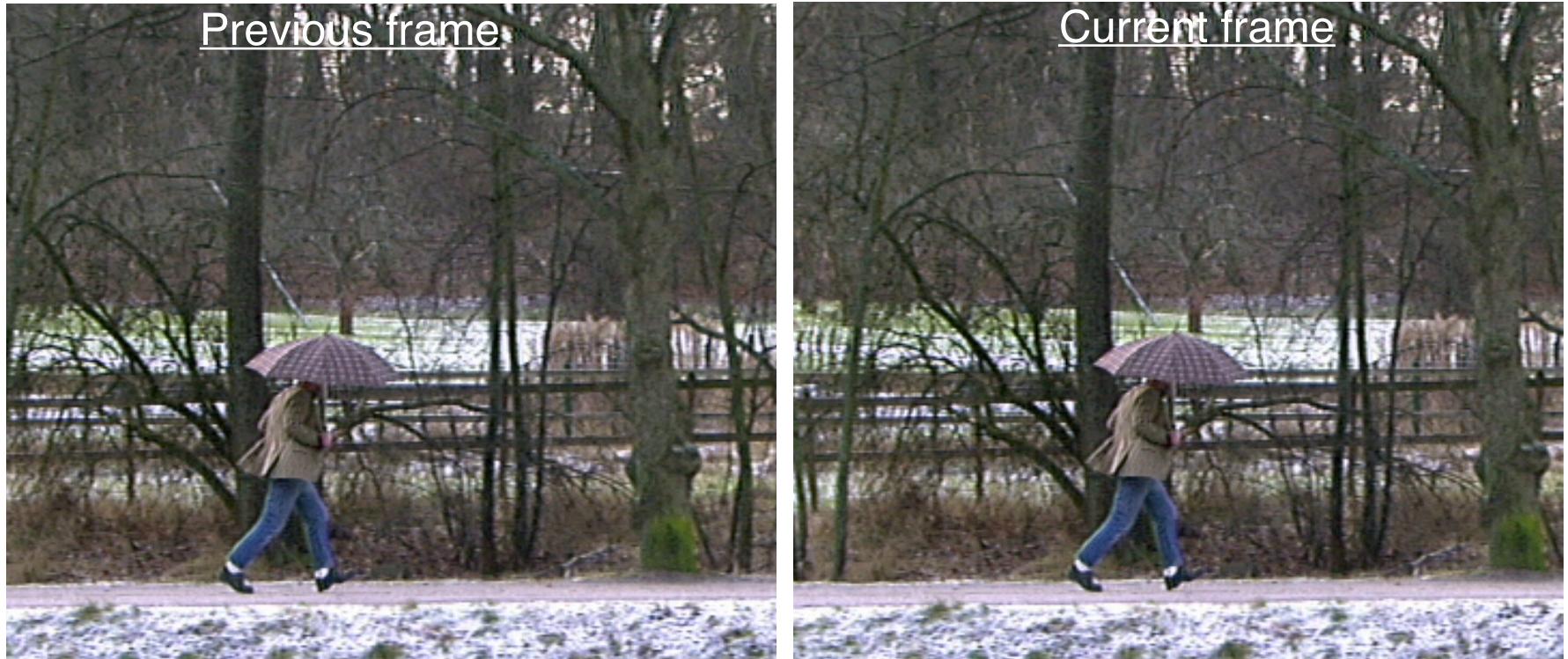
Using a Codebook of Videos



Problem: Decoder has to know all possible video sequences



Similarity of Successive Pictures



. . . is exploited by **inter-frame** coding



And at the Beginning of a Sequence?

- To be able to exploit inter-frame similarities, a **reference frame** is required.
- The first reference is processed by **intra-frame coding**.
- But how to code intra frames?



Intra-Frame Coding

. . . exploits the **similarity** among pixel values.

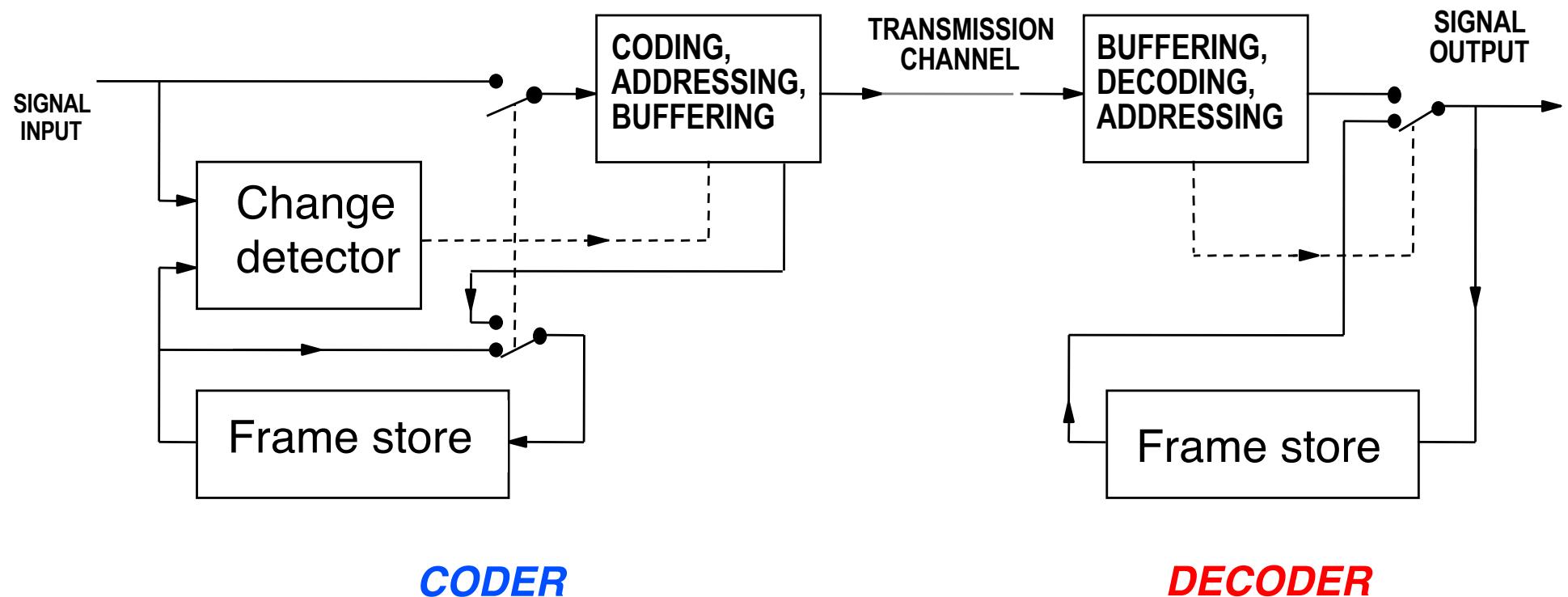


Interframe Coding

- Conditional replenishment
- Rate-distortion optimized mode selection
- Motion-compensated prediction
- Hybrid coding (interframe prediction + intraframe coding)



Conditional Replenishment

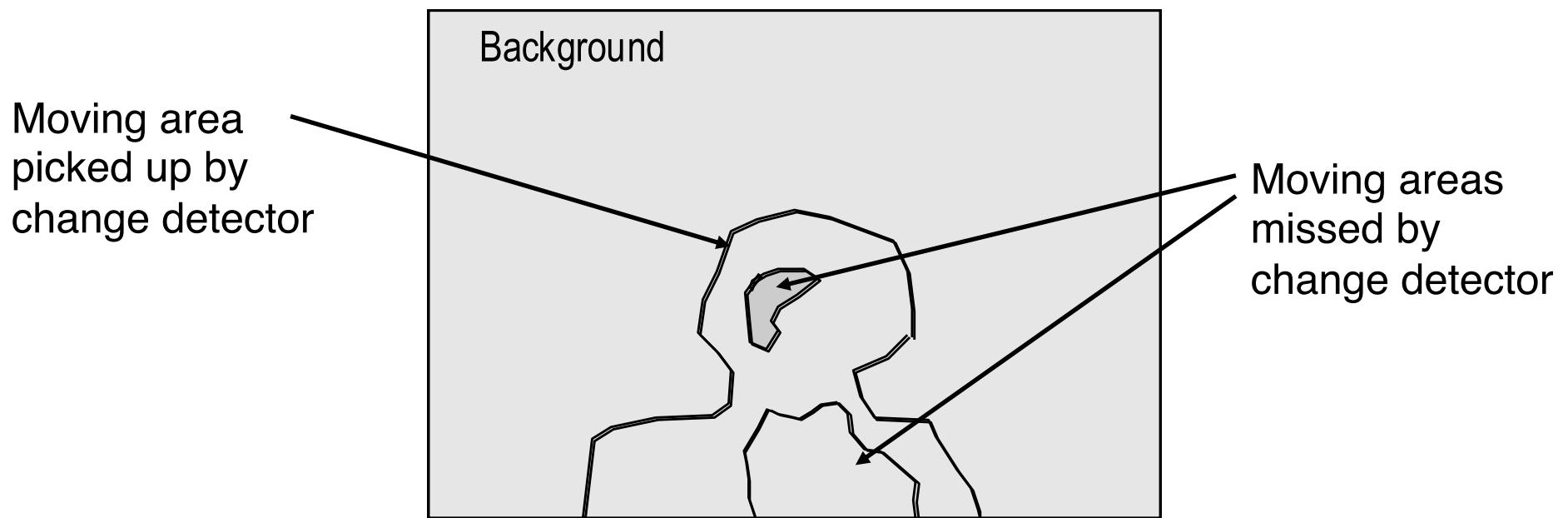


- Still areas: repeat from frame store
- Moving areas: encode and transmit address and waveform



The “Dirty Window” Effect

- Conditional replenishment scheme with change detection threshold set too high leads to the subjective impression of looking through a dirty window.



Rate-Distortion Optimized Mode Selection

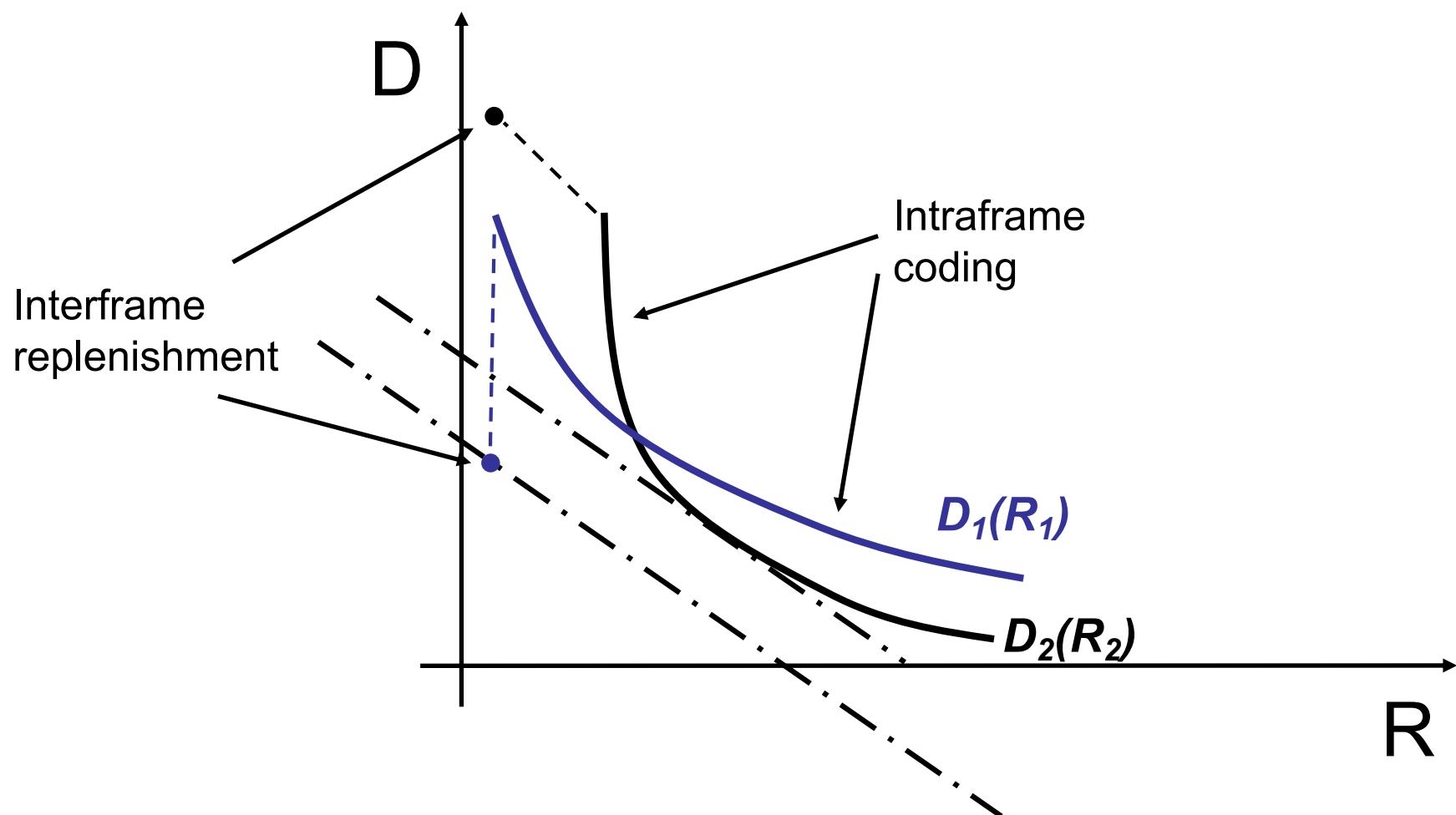
- How to choose the coding mode, if distortion D shall be minimized for a given rate R ?
- Assumptions
 - Blockwise mode selection, block index i
 - Additive overall distortion $D = \sum_i D_i$ and rate $R = \sum_i R_i$
- Lagrangian cost function

$$J = D + \lambda R = \sum_i D_i + \lambda R_i = \sum_i J_i$$

- **Strategy:** Minimize J_i for each block i separately, using a common Lagrange multiplier λ



Rate-Distortion Optimized Mode Selection



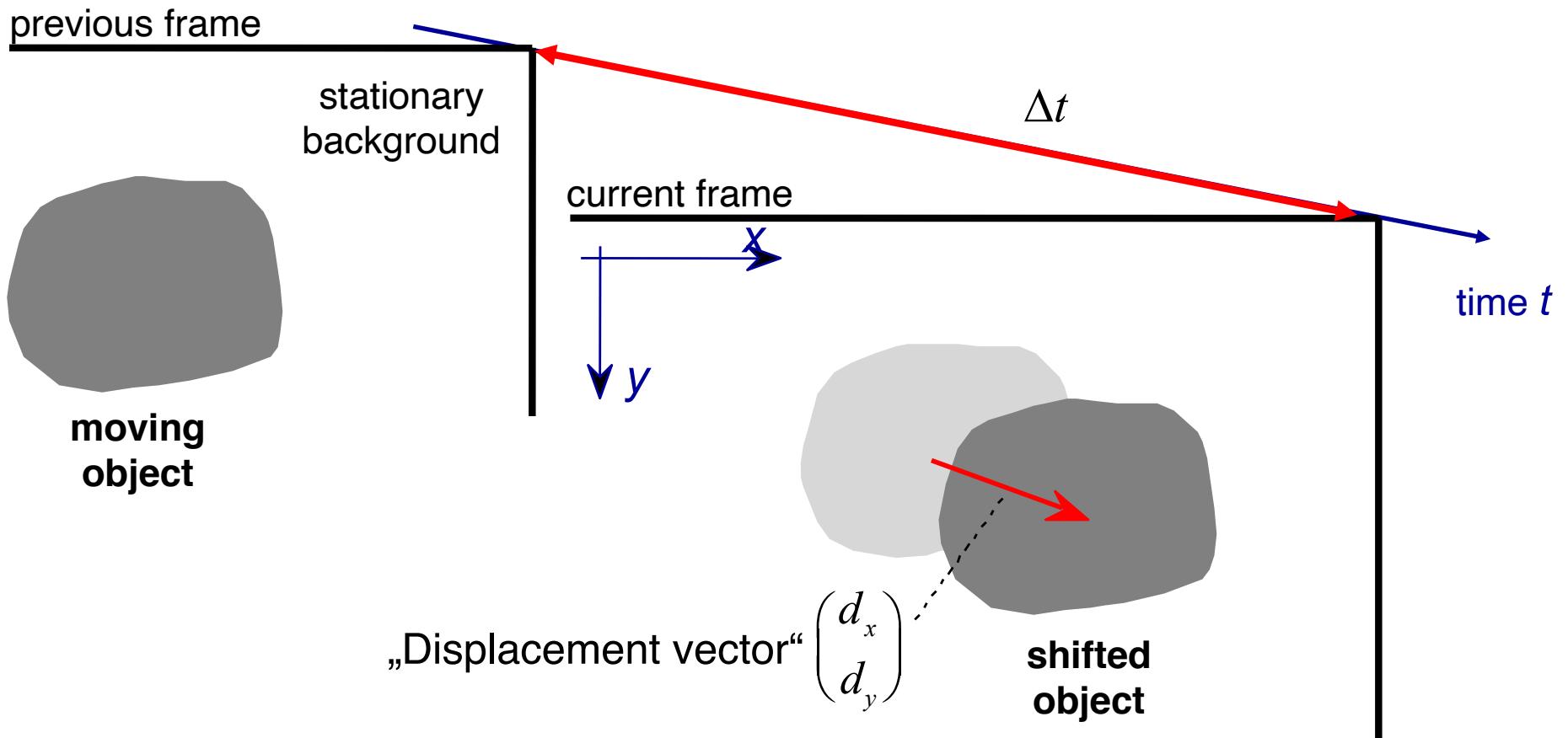
Successive Pictures



Similar, but objects appear shifted . . .



Motion-Compensated Prediction



Prediction for the luminance signal $S(x,y,t)$ within the moving object:

$$\hat{S}(x, y, t) = S(x - d_x, y - d_y, t - \Delta t)$$



Example for MC Prediction Error Image



Motion-Compensated Hybrid Coding

