Chair of Media Technology
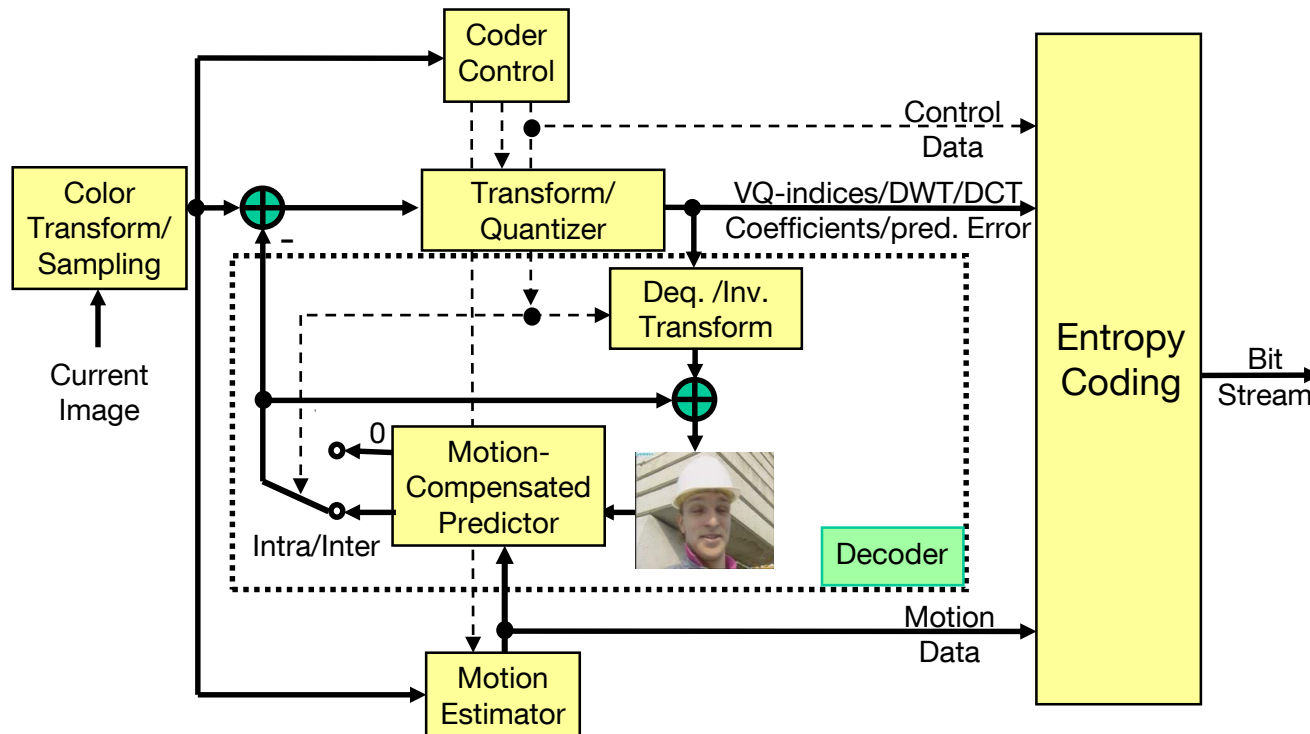Prof. Dr.-Ing. Eckehard Steinbach

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Hybrid Video Coder
IVC Lab SS20

Figure 1: Hybrid video coder (with embedded decoder)

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Chapter 1   Fundamentals

- **Distortion measure**
- Sampling, filtering and resampling   **downsampling**
                                              upsampling
- Color transform
- Rate-distortion performance
          evaluate the performance of a codec

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Distortion measure (image)

- Most commonly adopted two metrics:

- **MSE** (Mean Squared Error)

$$MSE = \frac{1}{W * H * C} \sum_{ijk} (\mathbf{Y}_{ijk} - \hat{\mathbf{Y}}_{ijk})^2$$

- **PSNR** (Peak Signal-to-noise Ratio)

$$PSNR = 10 * log_{10} \frac{(2^8 - 1)^2}{MSE} [dB]$$

- Advantages
  - Easy calculation
  - Mathematical tractability in optimization problems
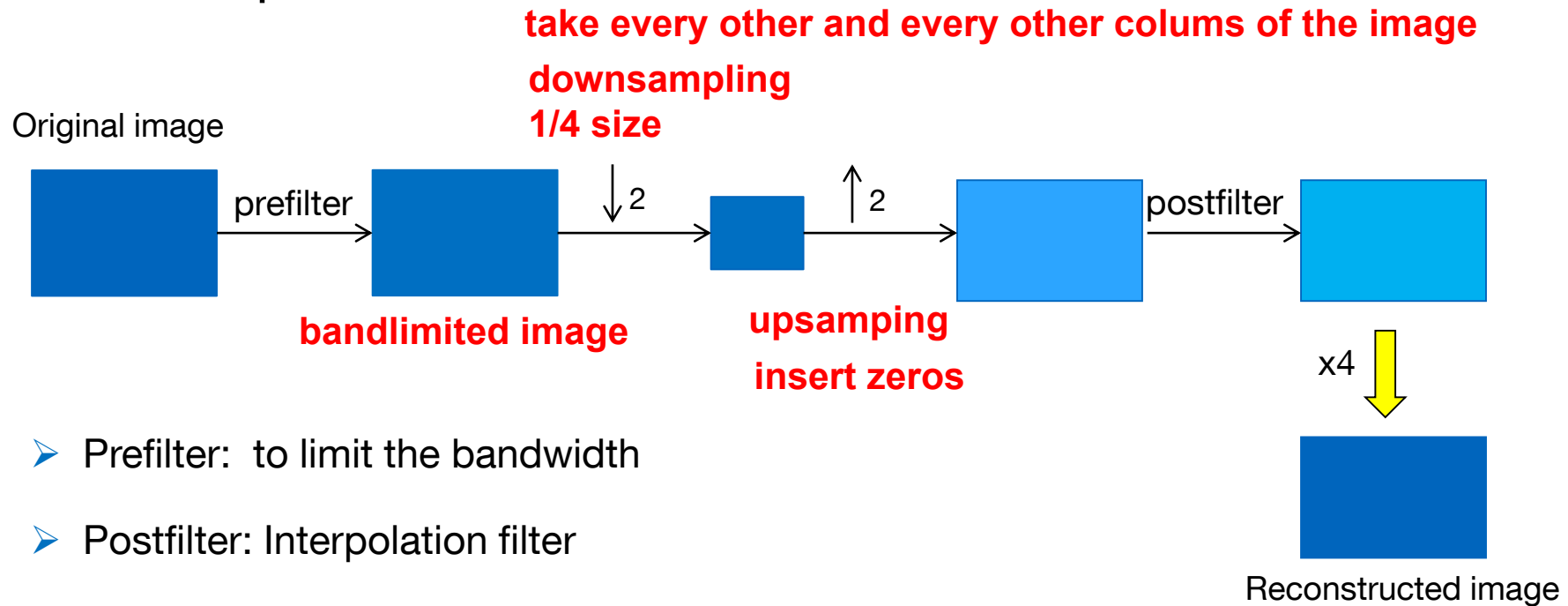 - Good for comparison of different algorithms
- Disadvantages
  - Neglects properties of human vision **for visual similar images may have different MSE or PSNR values**

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Pre- and post filter

take every other and every other colums of the image

downsampling

1/4 size

Original image

prefilter → $\downarrow 2$ → $\uparrow 2$ → postfilter →

x4

bandlimited image
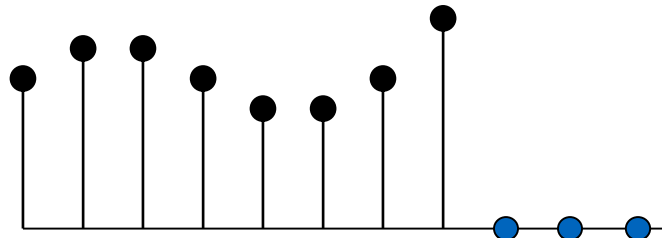
upsamping

insert zeros

Reconstructed image

➢ Prefilter: to limit the bandwidth

➢ Postfilter: Interpolation filter

➢ Postfilter should be the same as the prefilter

➢ Do not forget to normalize the filter: Filter_W = Filter_W / sum(Filter_W(:))

➢ Energy problem by using upsample()

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Border effect by filtering

边界问题：当处理图像边界像素时，卷积核与图像使用区域不能匹配，卷积核的中心与边界像素点对应，卷积运算将出现问题

Border of image (one side value)

- ## Caused by zero-padding
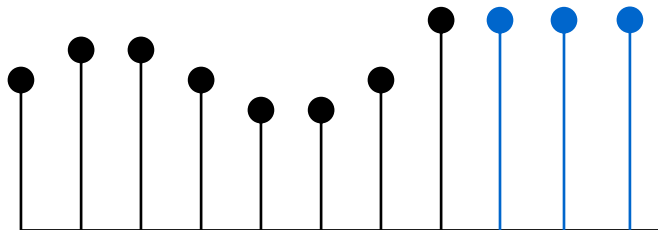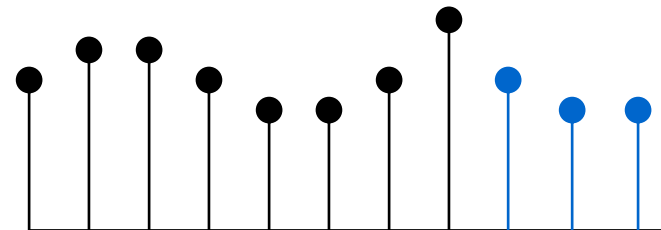
padarray() in Matlab!

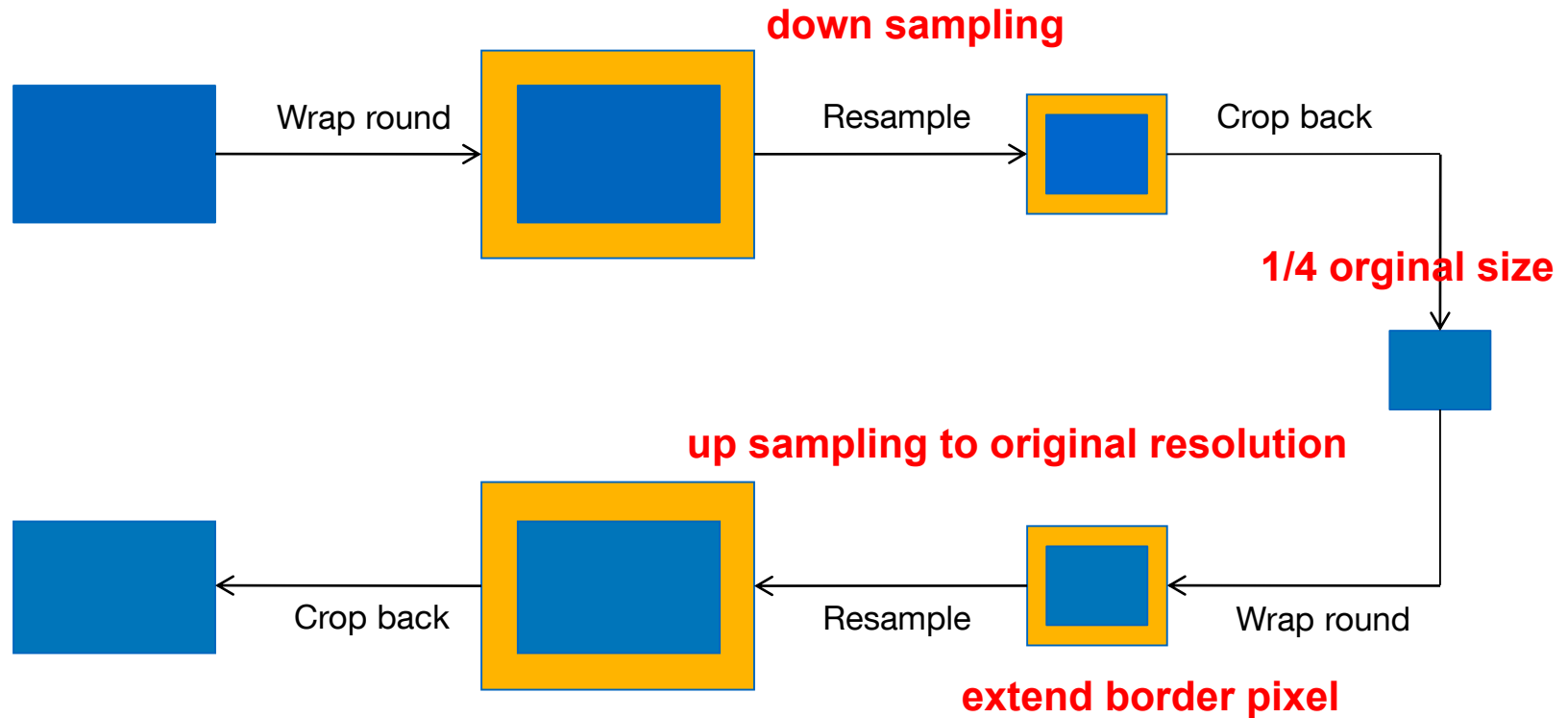- ## Solutions: border copying or mirroring

copying

mirroring

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Sampling, filtering and resampling

down sampling

Wrap round → Resample → Crop back

1/4 orginal size

up sampling to original resolution

Crop back ← Resample ← Wrap round

extend border pixel

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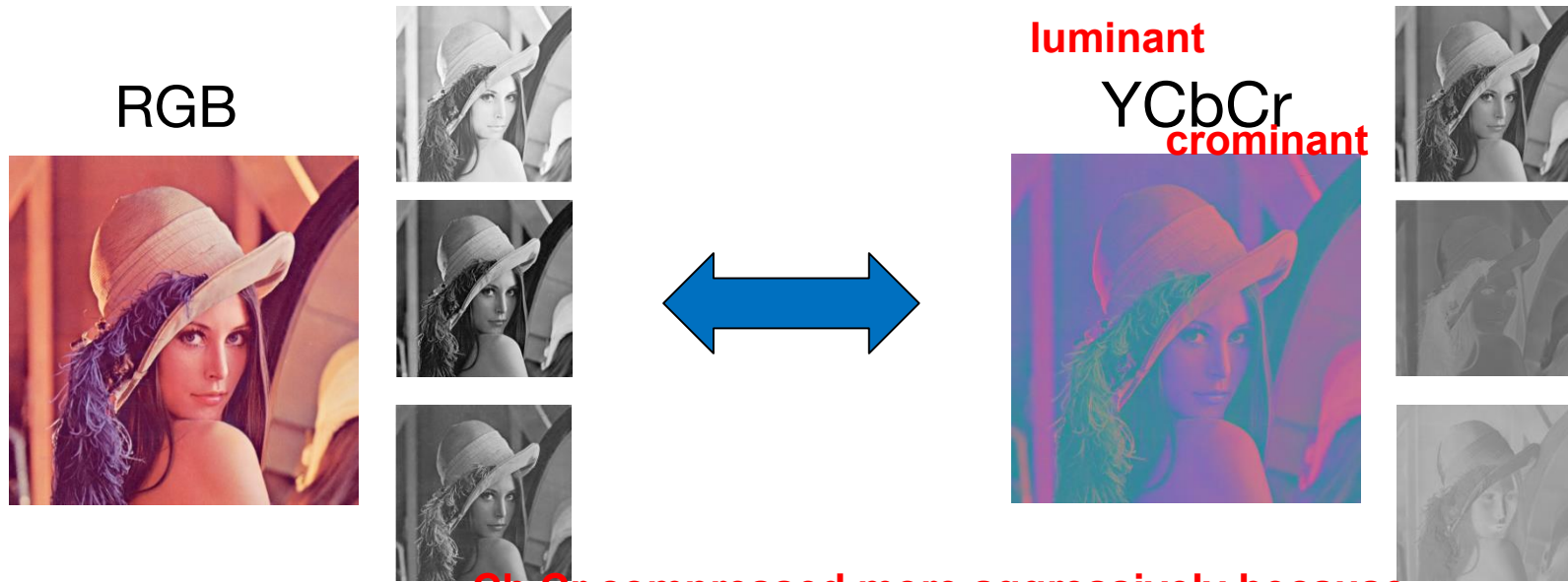Prof. Dr.-Ing. Eckehard Steinbach

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Color transform

- Human visual system

- RGB <--> YCbCr

**RGB not optimal for compression
because three channel of same importance**

RGB

luminant

YCbCr

crominant

**Cb Cr compressed more aggressively because
human vision are more sensitive to luminance
difference than color difference**

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Rate-distortion performance

- Bitrate = total bits / Num_pixel
- Num_pixel = Height*Width

- Non-compressed:
- 24 bits/pixel for color image
- 8 bits/pixel for gray image

Original Image

Encoder

Binary file

101
011
BIN

Reconstructed Image

Decoder

Distortion
(MSE, PSNR)

R-D Plot

bitrate