

9/25 - 1

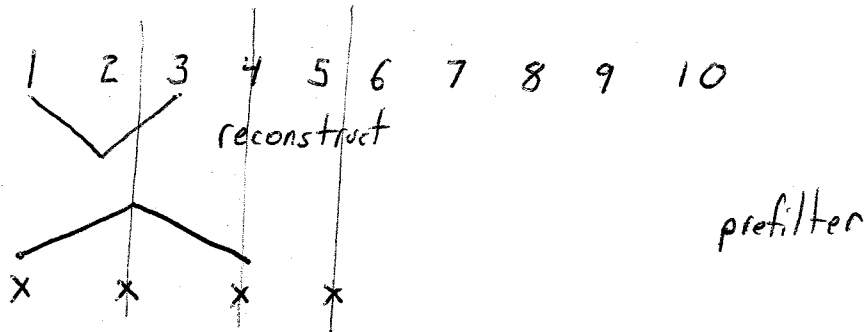
Resampling (1D, uniform)

for reconstruction: $r =$ width between source samples

for pre-filtering: $r =$ width between dest samples

hint: just pick the bigger one

$3/2$ resampling



Note: we only reconstruct (and evaluate pre-filter) at the samples

Alternate:

Upsample (reconstruct)

Filter (convolve w/ prefilter)

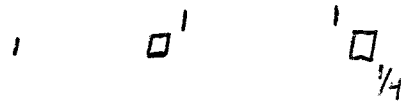
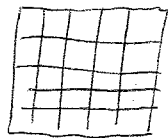
Sample

Show w/ box

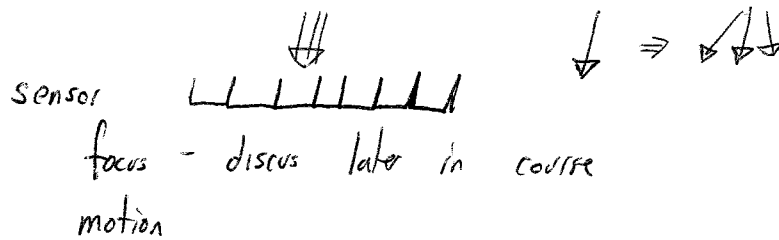
What do filters do to images

- ① per-pixel operations
 - brightness / contrast
 - color shift $(r, g, b) = F(r, g, b)$
 - non-linear (threshold, quantize, ...)

② linear filters - convolution



Blur = LPF $1 \ 1 \ 1 \approx \frac{1}{4} \ \frac{1}{2} \ \frac{1}{4}$



Unsharp Mask

Image - Blurred version = blurry part
so remove it

"High Pass Filter"

1 - LPF

$$[0 \ 1 \ 0] - [\frac{1}{4} \ \frac{1}{2} \ \frac{1}{4}] = [-\frac{1}{4} \ \frac{1}{2} \ -\frac{1}{4}]$$

often flipped $[\frac{1}{4} \ -\frac{1}{2} \ \frac{1}{4}]$

or even $[1 \ -2 \ 1]$

different 2D versions

$$\begin{bmatrix} 1 & -4 & 1 \\ & & \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & 1 \\ 1 & -8 & 1 \\ & & \end{bmatrix}$$

$$\begin{bmatrix} 1 & -2 & 1 \\ -2 & 4 & -2 \\ 1 & -2 & 1 \end{bmatrix}$$

Does HPF "Sharpen"

$1 + \alpha$ HPF

No!

Adds in high frequencies \leftarrow perceived as sharpness

How to Sharpen

De Convolution - hard (if kernel is LPP)

$$\begin{array}{ccccc} \cancel{f} & * & g & = & h \\ \uparrow & & \uparrow & & \uparrow \\ \text{image} & & \text{LPP} & & \text{blurred image} \end{array}$$

Problem 1 - deconvolution is hard (singular, sensitive)

2 - usually don't know g = BLIND deconvolution

Blending

$$\text{image} = (1 - \alpha) I_1 + \alpha I_2$$

Accumulation (paint strokes) \leftarrow note how last has more emphasis

Feathering (makes transition less obvious)

Airbrush

Clone Tool

Compositing

each pixel stores how "opaque" it is (α)

0 = empty / clear 1 = full (opaque) or 255

Matte = image of α channels

Over operator \Rightarrow blending