Q1: Spikes notation

Spike notation

\[ f(x) = \begin{cases} 1 & \text{if } x = 1 \\ 0 & \text{otherwise} \end{cases} \quad \text{impulse } \otimes 1 \]

- dot is infinitesimally small
- gap is infinitesimally small

Notation:

\[ \begin{array}{c}
\begin{array}{c}
\bullet \\
\bigcup
\end{array}
\end{array} \quad \text{book sometimes uses } \dagger \]
Q2-4: You didn't really explain Freq Domain
        How are we supposed to do anything with it?*
        Or understand it?

FOURIER NOTATION

Why are the graphs 2 sided?

\( \sin / \cos \) is a slight over-simplification

see p220 in the book

gives the right intuitions

unitless pictures

really use complex exponentials

pairs of frequencies give phase

We only do Frequency Domain for intuitions

- as a way of explaining the words
- as a way of motivating things
- as a conceptual tool for designing kernels / algorithms

* Can we see a concrete example -

No
TOTALLY SIMPLE VERSION

Box for Reconstruction
Spike for Pre-filter

⇒ new nearest neighbor
  round position to nearest sample

⇒ Analyze after explaining
  - wouldn't implement w/ general method
    (doesn't work well - special case in example code)
  - use sampling theory to understand
The real world

bucket to catch photons/count them

average over some region \Rightarrow 1 measurement
sample at center point

optical system does averaging too

pre filtering sampling

(370 100) (RGB) (RGB) \leftarrow 1 row

Display
value \rightarrow 3
splat! electron on phosphor CRT
electrons to LED
spurt of ink
Reconstruction by splatting!

Convolution "forwards" usually backwards $f()$ for each dest pt get each contribution

now forwards for each src pt put each contribution

Splatting paint artistic aliasing

Useful in non-uniform settings
A band limit intuition:

\[ \text{row of pixels} \]

what's the highest frequency you can show?

1 period = 2 pixels

Talk about:

1. width of filter in time domain
2. bandpass in freq domain

1 is generally easier in practice

average over this range = constant
What if the kernel is bad

\[ \begin{array}{c}
1 \quad 1 \quad 1 \quad 1 \quad * \quad \downarrow \quad \Rightarrow \\
\text{too narrow} \\
\text{a passband} \\
\uparrow \\
\text{excessive HF}
\end{array} \]

\[ \begin{array}{c}
1 \quad 1 \quad 1 \quad 1 \quad * \\
\text{too wide} \\
\text{-narrow passband} \\
\Rightarrow \\
\text{some blurring} \\
\text{some excess discontinuities} \\
\text{still HF (box is bad)}
\end{array} \]