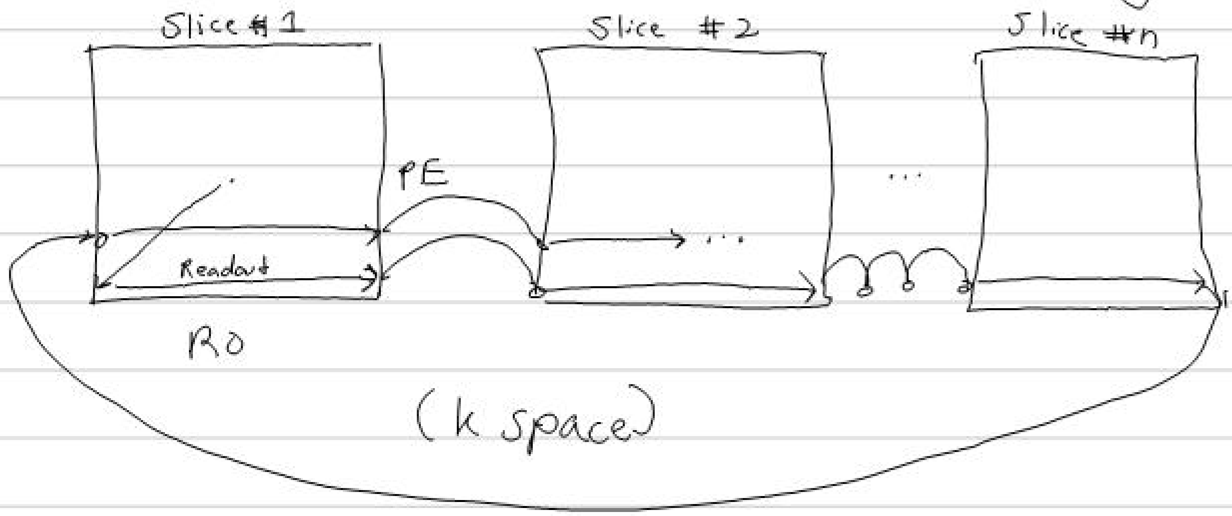
Image Acquisition Time; Field of View; Resolution

(long) <u>3D</u> Total Acq. Time = $N_x N_y \cdot TR \cdot N_{acq}$

<u>2D</u> $= N_1 \cdot TR \cdot N_{acq}$

What about multi ~~solid~~ ~~slid~~ slice "2D" imaging



Total Acquisition time is still $N_x \cdot TR \cdot N_{acq}$, but we've done more slices while waiting for the first slice to relax.

Step Size in k-space (constant gradient)

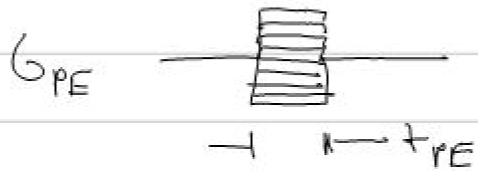
Readout, $\Delta k_{RO} = \frac{\gamma}{2\pi} \cdot G_{ro} \cdot \underline{\Delta t_{RO}}$

A to D converter dwell time

A to D is 50,000 complex points/sec, then $\Delta t_{RO} = 20\,\mu s$

This yields a 50 kHz bandwidth

Phase Encode, $\Delta k_{PE} = \frac{\gamma}{2\pi} \cdot G_{PE} \cdot t_{PE}$



$\Rightarrow \frac{\gamma}{2\pi} \int G(t)\,dt$ if gradient is not constant in time

Δk^{-1} = field of view (FOV)

Large FOV $\rightarrow$ Δk small $\rightarrow$ t_{PE} small or G_{RO} small

~~Example in 1D~~

If we perform a 1D Fourier transform, we see that we pull everything inside our field of view "aliased" in.

In 3D, $FOV = L_x + L_y + L_z$

$$= \underbrace{\underset{\underset{RO}{\downarrow}}{\Delta k_x^{-1}} + \underset{\underset{PE}{\downarrow}}{\Delta k_y^{-1}}}_{1\,cm \rightarrow 20\,cm} + \underbrace{\Delta k_z^{-1}}_{\text{slice thickness} \approx 1\text{-}3\,mm}$$

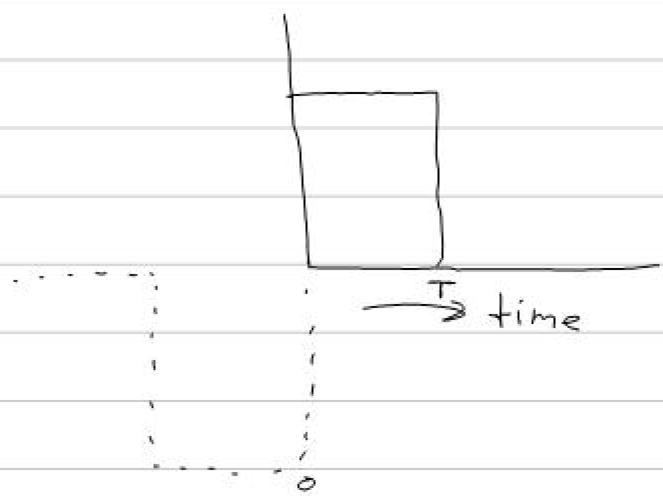
Resolution

P: $-\infty$ to $+\infty$

$-n \rightarrow n-1$

For fast FT, $N_{total} = 2n$

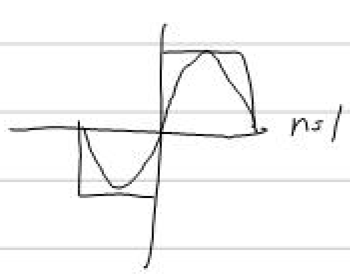
$(\Delta k_x)^{-1} = L_x = \Delta x \cdot 2n$; $\Delta x = \frac{L_x}{2n}$

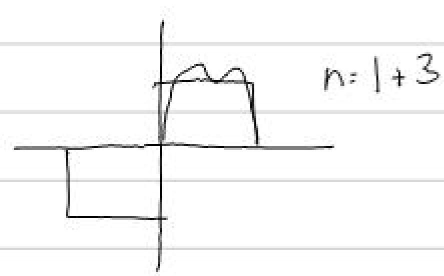


Approximate the shape with a sum of sines and cosines.

Cosine part of transform has the wrong symmetry.

$\sum_n B_n \sin\left[\left(\frac{n\pi}{T}\right) t\right]$ $\qquad t: 0 \rightarrow T$





n = 1 + 3 + 5

Collecting the spectrum of a box