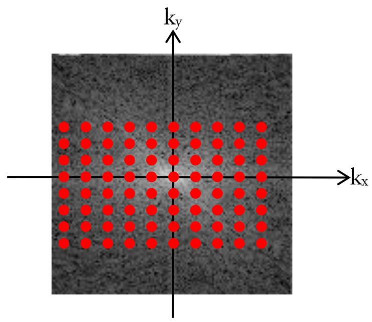
MRI Primer: Assignment #5

Due December 14, 2021

Setting Simple Imaging Parameters

A 2D gradient echo sequence is used to acquire a cartesian dataset in k-space, as shown schematically below:

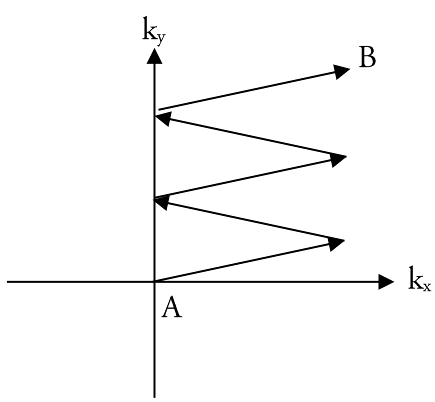


The imaged object is a human brain slice (say, 20 cm × 20 cm), and the desired imaging matrix is 256×256. Phase encoding is applied along y and frequency encoding is applied along x.

1. How would you select your field of view (FOV) along each of the axes? The FOV is defined as the periodicity of your point spread function.
2. What will happen if you set your FOV along the y-axis to 10 cm? Explain or draw how your final image will look like.
3. How many scans will you need to image the brain? A scan by definition is the "basic unit" that consists of excitation, acquisition and some delay (usually to let the magnetization recover before the next excitation).
4. If T_1=1 sec, and you choose to wait at the end of each scan for the magnetization to return to thermal equilibrium, how long will the entire experiment take (approx.)?
5. Calculate $k_{max,x}$, $k_{max,y}$ (total extent of data acquired in k-space along k_x & k_y axes), and Δk_x, Δk_y, the spacing between acquired points in k-space along the k_x and k_y axes.

Deducing the Gradient Waveforms from the K-Space Trajectory

Plot (schematically, in arbitrary units) the x and y gradients (that is, $G_x(t)$ and $G_y(t)$) which would give rise to the following path through **k**-space (in 2D), assuming that your initial point is A and final point is B (assume the path is traced continuously and evenly):



Deducing the k-Space Trajectory Given the Gradients

In the previous question you were given **k**(t) and were asked to schematically plot **G**(t). Now we're going to reverse the question: you're told that the x and y gradients are going to be varied as

$$\mathbf{G}(t) = \left(G_0 \sin\left(\omega t\right), G_0\right)$$

we'll be working in just 2 dimensions, x & y, for simplicity).

1. Plot $G_x(t)$ and $G_y(t)$ schematically as a function of time.
2. Compute **k**(t).
3. Plot $k_x(t)$ and $k_y(t)$ schematically.
4. Plot the trajectory **k**(t) in the k_x-k_y plane (as, for example, I've plotted in the previous question).