**Parallel Imaging Demo**

Magnetic resonance imaging (MRI) systems collect data in k-space, which is linked to actual image domain via a signal processing operation named Fourier Transform. Image characteristics such as resolution and FOV depend on k-space parameters as explained below.  
 **Image Resolution and FOV**:  
1) k-space resolution in a specific direction is inversely proportional to field of view (FOV) in the same direction.

=   
 =

2) Image resolution is inversely proportional to highest frequency obtained in k-space.

1. The number of points acquired in k-space
2. Spacing between the points in k-space
3. k-space extent

There are different sampling patterns used in MRI but this exercise focuses on cartesian sampling where k-space data in collected in a line-by-line fashion. Phase encode direction is along the and readout direction is along .

**Acquisition/Scan Time:**In 2D imaging, total image acquisition time is equal to total number of phase encode lines acquired, (), multiplied with repletion time also called, .  
**Motivation of reducing Acquisition Time** (could be added)  
  
To reduce acquisition time, we have the following two choices

1. Reduce
2. Reduce

Reduction in is not always feasible given the desired image contrast and their pulse sequence requirements. Also, rapid turning on and off of gradients may induce electrical pulses in patient, therefore, may violate specific absorption rate (SAR) limits.  
  
The second option is reduction of This can be achieved with either by decreasing while keeping This will yield low image resolution and given the clinical diagnosis requirement, it is not clinically viable to reduce image resolution.  
  
The other alternative could be increasing and keeping same which will cause aliasing artifacts because of violation of Nyquist sampling criteria but do not compromise on image resolution. The reduction in scan-time in directly proportional to acceleration factor, where acceleration factor, R, ratio of for fully sampled image to for under sampled image.  
  
  
  
  
Next:

1. Parallel Imaging
2. Receiver Antenna Arrays vs acceleration factor
3. Coil combination
4. Coil variation vs undersampling direction
5. Reconstruction Technqiues (image based SENSE, kspace based GRAPPA)