Bioengineering 278: Magnetic Resonance Imaging Laboratory
Winter 2012
Final Project

The goal of this project is to design and implement optimized RF and gradient pulses to excite a three dimensional pattern in space.

Design criteria:
Target object: described by spin3d.m, available on the class website **NEW**
Maximum Gradient amplitude: 5G/cm
Maximum Gradient slew rate: 20G/cm/ms
Raster: 4ms for both gradient and RF
Total pulse duration, including refocusing gradients: 32ms **changed from 20ms**

Due on March 7: A set of pulses ([pulse].rho, [pulse].theta, [pulse].gx, [pulse].gy, [pulse].gz) that generates a 3D excitation of the object. The gradient waveform for this lab should follow a Cartesian trajectory with uniform spacing, such that the RF pulse represents the 3D FT of the object. The quadratic phase modulation we used to improve the dynamic range of the 2D pulses has NOT been applied to the target object. You should choose how much, and in what direction(s) to apply quadratic phase modulation to improve your pulses.

Due on March 16: A set of pulses that generates a 3D excitation of the same object, using a gradient trajectory that improves the accuracy of the generated spin pattern. The gradient waveform for this lab should be optimized to:

1. Traverse K-space more time efficiently.
2. Cover K-space in a pattern that more closely matches the distribution of energy in the FT of the object.

The RF pulse should be compensated to correct for variations in the density of sampling of K-space, as well as for the effects of any gridding kernel that may have been used in interpolating the data onto the chosen trajectory.

Due on March 23: A write up of both portions of the pulse design lab (Cartesian and Optimized). This should include the code that generated both pulses, a description of the design processes and the concepts behind the optimization process for the second pulse, and a comparison of calculated and experimental profiles. Code can be common to all students, but the description of the design process should be unique to each student.