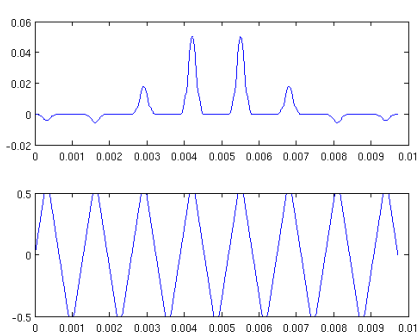
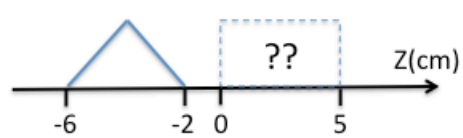
Bioengineering 278: Magnetic Resonance Imaging Laboratory
Winter 2012
Lab 4

1. **The Spatial-Spectral Pulse (Wednesday)**
   The spatial-spectral pulse is designed to excite a slice in space, but excite only water or fat, but not both. The goal of this lab is to plot the 2D response of the pulse in z-f (space-frequency) space, both experimentally and theoretically. The B1 and Gz for the pulse is shown below, and is given in the file lab4.mat on the class server. In lab4.mat, B1(rho) is in G, Gz is in G/cm and the timebase in s is in the vector t. For this lab use the pink spherical phantom in the birdcage coil. This phantom is relatively non-conductive and supports very uniform B1. Use our homemade pulse sequence 'slicpro', and set rhexecctrl to 11. Acquire an axial image of the slice profile, with frequency encoding L/R. In Manual Prescan, offset the Y shim value by 100 units and rescan. This adds a static linear gradient in the Y direction, and makes the image a map of z-f space. To calculate the expected response in z-f space: For each location z, the local frequency is $\gamma G(t)z$. Transform the pulse into a rotating frame that rotates with the spins. The FT of this transformed pulse is the frequency response at position z. Repeat for z=-10:(20/256):10 cm Display the response to the pulse as an image in z-f space, and label the axes in cm and Hz (8 points).
   By comparing your image with your calculated response, calculate the gain of the shim system in G/cm per adjustment unit. (4 points)

2. **Small tip pulse design (Friday)**
   Design and bring to lab a small tip RF pulse which, when applied in the presence of a 1G/cm gradient, will produce an excitation profile with a triangular feature and one additional feature of your choice that is non-zero on the interval z=[0-5]cm, and zero elsewhere, as shown below. The pulse should be 4.096ms in length, and described by 512 points sampled at 8μs per point. Each student should provide a different pulse. Measure the response of your pulse using the slicpro sequence, and compare your theoretical and measured responses. (8 points)