

# Bioengineering 278: Magnetic Resonance Imaging Laboratory

## Winter 2011

### Lab 6

The goal of the lab this week is to design, implement, and test an RF pulse and accompanying gradient that will ‘paint’ the following smiley face of magnetization into a uniform spherical phantom. The matlab code that generates the smiley face is smiley.m, and is available on the website. In the design portion of the lab, we will use matlab to generate four files: testrf.rho, testrf.theta, testrf.gx, and testrf.gy, which contain the RF and gradient waveforms for the excitation in X and Y. In the testing portion of the lab, we will use a custom pulse sequence that will apply our new pulse, with a refocusing pulse on the Z axis to refocus only one axial plane, and acquire an image using a conventional spin echo acquisition.

The trajectory in excitation K-space should be a Cartesian raster, like EPI, and the deposition of RF power should be the Fourier Transform of the smiley face (ie we make the assumption that we are in the low flip angle regime). When designing the pulse, keep in mind the following limits:

Gradient Amplitude: 4G/cm  
Gradient Slew Rate: 15G/cm/ms  
Max RF amplitude: 0.14G  
Gradient and RF raster: 4 $\mu$ s



The design FOV should be 16cm.

The waveform should not exceed 40ms in total length to limit T2\* decay during the pulse.

The trajectory should return to the center of excitation K-space at the end of the pulse to make sure the spins are in phase.

Files should be 16bit signed integers, with max amplitude (32767) of 4G/cm for the gradient waveforms, 0.14G for the rho (RF amplitude) waveform, and  $\pi$  for the theta (phase) waveform.

The design, implementation, and testing will be a group effort, but lab write-ups should be individual. Scoring will be: 15 points for detailed commenting of the function of each piece of the matlab code that we co-write to design the pulses; and 5 points for a discussion of the artifacts and distortions that we see in the results.