MP/BME 710 Homework (due on Monday, September 24th, 2018)

Please submit your homework electronically through the course webpage on Learn@UW. Scanned handwritten notes are perfectly acceptable for this homework.

1. 20 points Assume that a spin system with a single resonance component was at thermal equilibrium. Calculate the transverse magnetization resulting from the following excitation sequences:

(a) $90_{x'}{}^{o}$ $90_{y'}{}^{o}$

(b) $90_{x'}{}^{o}$ - τ - $90_{y'}{}^{o}$

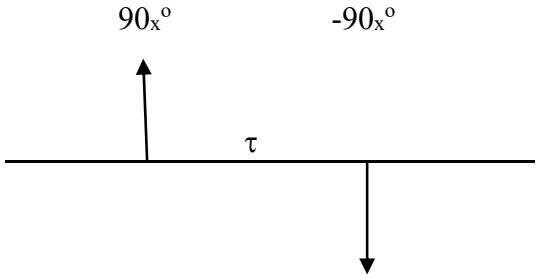
(c) $45_{x'}{}^{o}$ $90_{y'}{}^{o}$

2. 20 points Calculate and depict the bulk magnetization of a spin system relative to the prepulse reference frame after a $90_{x'}{}^{o}$ pulse. Assume that the Larmor frequency of the spin system is 10 MHz, the pulse lasts 1.0 ms, and the prepulse condition is $M_{x'}(0_-) = M_{y'}(0_-) = 0$ and $M_{z'}(0_-) = M_z{}^{o}$.

3. 20 points. Use rotation matrices to determine the final magnetization for the following scenerio: Initially, the magnetization (**M**(0)) is oriented along the z direction. The magnetization experiences a 90 degree rotation about the x' axis, followed by a delay of τ seconds, and then finally, a -90 degree rotation about the x' axis.

(a) What is the magnetization vector immediately following the second 90 degree pulse?

(b) If a gradient Gz is applied during the τ period between pulses, what is the magnetization vector as a function of z following the second 90 degree pulse?



4. **10 points** Briefly (in one or two sentences) explain why a spin echo is T2-weighted but a gradient echo is T2* weighted.

5. 30 points Calculate the location and amplitudes of all the echoes generated by the following sequence while considering relaxation effects:

$90_{y'}{}^{o}$ - τ - $180_{y'}{}^{o}$ - 2 τ - $180_{y'}{}^{o}$