EE 591: Magnetic Resonance Imaging and Reconstruction — Fall 2009
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Midterm Exam #1

Thursday, Sept 17th, 2009

- This is an **80 minute**, closed book, closed notes exam.
- You may use one handwritten "crib" sheet. No other written material is allowed.
- There are **four problems**. The relative point values are listed, however, we reserve the right to modify these weightings. Bonus points may be awarded for excellent answers.
- **No calculators.**
- Partial credit can be important so don't get stuck on any one problem.
- **Read each problem carefully.**

1. **(30 pts)** Indicate whether the following statements are TRUE or FALSE. Explain your answers enough so that we know you are not guessing.

   a. The MRI signal becomes stronger when the temperature of the sample is decreased.

   b. During an experiment, the magnitude of the macroscopic magnetization vector ($\vec{M}$) is always preserved, and is denoted M_o.

   c. In 2DFT imaging, the spatial resolution along the phase-encode direction is equal to the FOV divided by the number of acquired phase encodes.

2. **(25 pts)** Consider the 2D function: $f(x,y) = sinc(x)sinc(y) - jinc(\sqrt{x^2+y^2})$
   Find its projection $g_\theta(x')$, for (a) $\theta=0°$ and (b) $\theta=45°$.

3. **(15 pts)** The magnetization ($\vec{M}$) precesses about the applied field vector ($\vec{B}$) according to the left hand rule. Draw a picture of this, and derive the rate of precession based on the Bloch equation.

4. **(30 pts)** Consider a square object $m(x,y) =^2 \sqcap(x,y)$ imaged using the pulse sequence shown below. The G_y pulse and generates 3π of phase across the object. The G_x pulse generates 6π of phase across the object. Sketch (a) the k-space trajectory and (b) the baseband signal that is generated. Be as precise as possible.