Medical Physics 710 / BME 710 **Due: Oct. 15th, 2018**

Journal Discussion #4: **M Lustig et al.,** MRM 2007, **Sparse MRI: The Application of Compressed Sensing for Rapid MR Imaging.**

Due: October 15th at beginning of class. Please turn in by hand, email, or submission to Learn@UW.

Name:

Question 1 (2 points)

Compressed sensing theory requires 'incoherent sampling' artefacts from undersampling.

a. How can that be achieved when using a (A) Cartesian 2D and a (B) Cartesian 3D acquisition?

b. Is one of these sampling schemes (Cartesian 2D vs Cartesian 3D) better suited to fulfill the requirement of incoherent sampling artefacts.

Question 2 (2 points)

Besides sparsity, what are other conditions should be met for a compressed sensing reconstruction according to the CS theory?

Question 3 (2 points)

Which of the following is a true statement about the Constrained Optimization problem used in CS image reconstruction?

(1) The L2 norm is used to measure the reconstructed image in the sparse transform domain since it penalizes large coefficients.

(2) The parameter ε represents the minimum allowable difference between the Fourier transformed reconstruction and the measured k-space data (under the L2 norm).

(3) The sparse transform ψ may be any non-linear operator besides the identity matrix.

(4) The use of the L1 norm in the sparse transform domain is crucial since it often results in a solution comprised of a small number of large coefficients.

(question 4 on next page)

Question 4 (4 points)

Briefly explain how the sparse signal shown in Fig 2a can be properly recovered from pseudo-random k-space undersampling shown in (b), resulting in the signal representation in (d) with a direct reconstruction. Hint: you don't have to explore this with mathematical rigor, an intuitive description is sufficient.