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

**Journal Discussion 9: Hagmann et al, 2006: Understanding Diffusion MR Imaging Techniques:**

**From Scalar Diffusion‐weighted Imaging to Diffusion Tensor Imaging and Beyond**

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

Question 1: Explain the difference between molecular displacement, diffusion, and flux. (3 points)

* Molecular displacement is the distance (**)** which a water molecule randomly travels in a time interval . Often replaced with the more specific term, *diffusion*.
* Diffusion refers to the random displacement of molecules in a fluid caused by thermal energy.
* Flux is a type of molecular displacement that causes *all* molecules to be displaced over a nonzero distance.

Question 2: What factors determine the *b* value used for diffusion weighting?

(2 points)

The b-value is proportional to the product of the square of the gradient (q2) and the diffusion time interval (). More specifically:

Question 3: What is an advantage and disadvantage of using a longer diffusion time interval? (2 points)

If the diffusion interval is longer, then there is more time for the displacement distribution to develop. This leads to better resolution of diffusion. However, this decreases SNR. This is because longer diffusion time intervals lead to longer times before readout, which leads to increased dephasing of spins, ultimately leading to decreased signal and thus SNR.

Question 4: True or False. (3 points)

a. Areas of high diffusion will lead to high signal intensity in a diffusion‐weighted image.

**FALSE.** This will lead to decreased intensity.

b. To obtain an image of ADC values, two acquisitions are necessary.

**TRUE.**

c. Diffusion tensor imaging requires a minimum of 6 acquisitions.

**FALSE.** We need at least 6 acquisitions to fill out the 3x3 matrix (and use symmetry to fill out the rest) as well as an additional reference scan.