Bioengineering 278: Magnetic Resonance Imaging Laboratory
Winter 2009
Lab 9 - Week of 3/02

For this lab you will use the diffusion features in spep. For all experiments, use the T/R birdcage head coil. Spin echo. Single axial slice with slice thickness 5mm. Relevant CV's are:

dif	1	Switch for diffusion weighting
pw_gd		δ is pw_gd + 400us
a_gxd	0 or 4	Amplitude of X diffusion grad in G/cm
a_gyd	0 or 4	Amplitude of Y diffusion grad in G/cm
a_gzd	0 or 4	Amplitude of Z diffusion grad in G/cm
		Assume $\Delta = \delta + 5.5$ms
vdif	1	Stepped diffusion per rep with linear ramp of gradient amplitude across reps
vdif_ramp	10	Number of b values
reps	10	Number of image (1 per value of diffusion weighting)
dda	2	Dummy scans

1. **Measure diffusion anisotropy in a phantom**. Use a pineapple or similar phantom and an FOV of 16cm. Variable diffusion in X, Y, Z. Calculate values of pw_gd to give a bmax of approximately 1000s/mm^2.
    a. **Single shot**. Collect one diffusion weighted run with diffusion weighting in each [XYZ] direction, opxres=64 and nl=1.
    b. **Two shot**. Collect one diffusion weighted run with diffusion weighting in each [XYZ] direction, opxres=96 and nl=2.
    c. Calculate maps of: Dxx, Dyy, Dzz, Trace, and Anisotropy (Var(Dnn)) for both single shot and two shot data. Provide absolute scales for these maps.
    d. Would you expect anisotropy to be higher or lower with higher resolution? Why?
2. **Measure diffusion and motion in brain**. Human subject. FOV 22cm. Variable diffusion in X, Y, Z. Calculate values of pw_gd to give a bmax of approximately 1000s/mm^2.
    a. **Single shot**. Collect one diffusion weighted run with diffusion weighting in each [XYZ] direction, opxres=64 and nl=1.
    b. **Two shot**. Collect one diffusion weighted run with diffusion weighting in each [XYZ] direction, opxres=96 and nl=2.
    c. Calculate maps of: Dxx, Dyy, Dzz, Trace, and Anisotropy (Var(Dnn)) for both single shot and two shot data. Provide absolute scales for these maps.
    d. Calculate the phase shift per unit distance (k-space coordinate) at the end of the first diffusion weighting gradient pulse for each of your 10 b values.
    e. **Calculate maps of RMS brain velocity in the Z direction.** Which data is most appropriate for making this measurement?
    f. **As diffusion weighting increases what do you notice about the image quality for nl=1 vs nl=2?** What accounts for these differences? Relate your findings to part 2d.