BIOEN 6330 Principles of Magnetic Resonance Imaging

Instructor: Edward W. Hsu, Ph.D.
Merrill Engineering Building 2478
Phone: 585-7550,
Email: edward.hsu@utah.edu

Topics:
- linear systems review
- nuclear magnetic resonance phenomenon
- Bloch equation
- magnetic field gradients and k-space
- spin warp imaging
- signal equation, image resolution and SNR
- basic MRI instrumentation
- image artifacts

Grading Scheme:

Problem sets:	25%*
Midterm exam:	25%
Laboratory exercises:	25%
Term paper:	25%

*See separately attached policies for assignments

Required Textbook:

E. M. Haacke, et al. Magnetic Resonance Imaging – Physical Principles and Sequence Design. John Wiley & Sons, Inc., 1999.

Additional References:

- Z. P. Liang and P. C. Lauterbur. Principles of Magnetic Resonance Imaging, A signal processing perspective. New York: IEEE Press, 2000.
- P. Callaghan. Principles of Nuclear Magnetic Resonance Microscopy. Oxford: Clarendon Press, 1991.
- C. Slichter. Principles of Magnetic Resonance. New York: Harper and Row, 1963.
- D. Stark and W. Bradley, Jr. Principles of Magnetic Resonance. St. Louis: Mosby-Year Book, 1992.
- *Magnetic Resonance in Medicine*
- *Magnetic Resonance Imaging*

Spring 2006 BIOEN 6900.02 – Principles of MRI

Term Paper Requirements

To cover the diverse breadth of the field, each students will present one (1) research term paper on a selected topic of MRI:

1. The term paper topic needs to be *pre-approved* by the instructor no later than **March 10**.
2. No topic can be duplicated once selected by another student.
3. Report should provide a concise, but comprehensive overview of the area, based on the *minimum* of 5 original journal papers (i.e., review papers do *not* count), and focusing on materials not already covered in the lectures.
4. Reports for graduate students should also include some element of novelty such as suggestions or demonstrations for new or future technical development.
5. Report should be given in a 30-minute in-class presentation. The use of visual aids (slide show, handouts, etc) is encouraged.
6. A written report (10 – 15 pages in length) is also required and is due on the last day (5:00pm) of classes, Wednesday, **April 26**.
7. Each report will be graded based on its (a) breadth of coverage, (b) depth of technical understanding, (c) element of novelty, and (d) quality of presentation.

As bioengineering students, the topics of the report should primarily cover the technical development of MRI – biomedical applications should be included only as the rationale for the work. Topics focusing on extension of standard MRI techniques to biomedical applications or analysis of post-acquisition MR images will not be accepted.

Sample topics:

Methodology of MRI (essentially any non-conventional imaging acquisition and/or reconstruction schemes):

- SENSE , SMASH or other "parallel" imaging
- Reduced encoding or partial k-space imaging
- Projection reconstruction or spiral imaging
- Echo-planar imaging
- Diffusion tensor imaging
- Perfusion imaging
- Functional MRI
- MR elastography
- MR tagging