BMB 630: Advanced Topics in MR  
Fall, 2010

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Website: http://www.mmrrcc.upenn.edu/mediawiki/index.php/BMB_630

Time: 2-3:30 PM, Tuesdays formal meeting (rest of the time informally).  
Location: B1 Stellar-Chance Labs conference room (Basement)

Course Description: Advanced topics in theory and applications of magnetic resonance spectroscopy and imaging of biological tissues and solid-state materials to problems in biochemistry, biology, bioengineering and medicine.

Course Schedule:

<table>
<thead>
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<th>Date</th>
<th>Topics</th>
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<tbody>
<tr>
<td>9/14</td>
<td>Course Overview</td>
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<tr>
<td>9/21</td>
<td>Topic I Selection Deadline</td>
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<tr>
<td>9/28</td>
<td>Project update</td>
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<td>10/5</td>
<td>Project update</td>
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<td>10/12</td>
<td>Project update</td>
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<tr>
<td>10/19</td>
<td>Student Presentations</td>
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<td>10/26</td>
<td>Student Presentations</td>
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Overview:

The students will make a 45-minute presentation on their work and provide a manuscript of their results in the style of a Note to Magnetic Resonance in Medicine. An overview of the expectations for the article and presentation will be given during the lecture on 9/14.

A. Choosing Your Topic

The students may choose from the topics below or suggest their own:

- $^{23}$Na or $^{17}$O Imaging
- Adiabatic Radiofrequency (RF) Pulses
- Composite RF Pulses
- Dipole-Dipole Interactions in an $A_2$ System
- Field Gradients in MRI
- Functional Magnetic Resonance Imaging (fMRI)
- Magnetization Transfer
- Measuring Two-Site Chemical Exchange
- Multiple Quantum Filter MRI
- Magnetic Susceptibility Imaging
- RF Coil / Probe Design
- $T_1$ and $T_2$ Relaxation
- $T_1p$ Relaxation and Spin Locking
A useful reference for choosing your topic is Malcolm Levitt’s, ‘Spin Dynamics: Basics of Nuclear Magnetic Resonance,’ which contains an introduction to NMR or Ray Freeman’s, ‘A Handbook of Nuclear Magnetic Resonance,’ which has short summaries of many key topics in magnetic resonance. To choose your topic, you may also find it helpful to schedule time to meet with either of the instructors. You can contact any of us by email to schedule a discussion.

2. Obtaining Data for Your Manuscript

Once you have chosen a topic, you will need prepare a related hypothesis and collect data to support it. You may choose to repeat a previous experiment, extend the previous work of others, or develop your own experiment. Some examples of questions you could ask related to the topics above are:

(Two-site chemical exchange): Can you measure the on/off exchange rate for protons at the sites of amide/amine/hydroxyl groups in a specific protein or molecule?

(T1 or T2 Relaxation): How does contrast in MR images relate to the rotational correlation time of tissues in or ex vivo?

(Spin Echoes): How do CPMG pulse trains increase the apparent relaxation time in a spin echo experiment?

(Multiple Quantum Filters): How can you measure the intracellular sodium concentration using multiple quantum filters?

(fMRI): Can individuals be desensitized to a stimulus during an fMRI experiment?

(Magic Angle): Why are magic angle experiments useful in solid state NMR? or Can you measure tissue anisotropy (i.e. in tendon or cartilage) by observing magic angle phenomenon?

Once you have a specific question in mind (either your own or something you have read previously), you need to perform experiments to test the hypothesis. There are four MR instruments available for your use a 500 MHz liquid spectrometer equipped with a dual 1H/13C probe (for 600 μL solution samples) and a 1.5 or 3T and 7T clinical imaging system. To schedule time on one of the instruments, you need to contact the instructor who will join you to perform the experiments.

3. Data Analysis

Software for analyzing your data is available in both Matlab and IDL. Depending on your experiment, we will help you decide which you need. You are welcome to analyze your data using other software using a spreadsheet program like Excel or a low-level programming language like C++.

4. Format

Once you have obtained data and prepared your figures, you will need to write a manuscript.

The format for your manuscript will in the style of a Note to the Magnetic Resonance in Medicine. MRM recommends that the length of a Note be maximum of 9 pages (double spaced)
in addition to a couple of figures, and maximum of 20 references. Guidelines for the format can be found on the website:

http://onlinelibrary.wiley.com/store/10.1002/(ISSN)1522-2594/asset/homepages/style.pdf?v=1&s=197a2555b1249e245a6aaa9e7c56fdd8bfbd4ade

Endnote Web is useful software packages for managing references in your manuscript. The software allows you to download citations rather than type them in by hand. Endnote Web maintains a database of your references online for easy editing and insertion into your manuscript. Endnote Web is free to Penn students by creating an account using your Penn email address.

5. Presentation

In addition to the manuscript, you will give a presentation on your work. Your presentation will be assessed for several features:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Content</td>
<td>(10%)</td>
</tr>
<tr>
<td>Introduction and Background</td>
<td>(15%)</td>
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<tr>
<td>Theory</td>
<td>(25%)</td>
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<tr>
<td>Analysis of Data</td>
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<tr>
<td>Discussion of Results / Future Research</td>
<td>(10%)</td>
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<tr>
<td>Organization</td>
<td>(10%)</td>
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<tr>
<td>e.g. opening statement, outline, introduction, motivation, discussion, and conclusion.</td>
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<tr>
<td>Language</td>
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<tr>
<td>Appropriate scientific language for audience, proper use of jargon, correct grammar.</td>
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<tr>
<td>Physical Behavior</td>
<td>(10%)</td>
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<td>Proper pace, good eye contact, and composure.</td>
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<tr>
<td>Visuals</td>
<td>(10%)</td>
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<td>Legible, simple, clear and appropriate for topic and for audience, good graphics.</td>
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6. Grade

Your final grade will be determined by your manuscript and presentation.

(50%) Manuscripts
(50%) Presentations

Selected Books for Reference:


Selected Original Articles:


