BME: 495-0-21 Functional Imaging
2016 Spring

Lecture Time and Room: T, TR 6:00-7:30 pm, Lunt Hall 104

Instructors:

Alice M. Wyrwicz, PhD, Adjunct Associate Professor of Biomedical Engineering
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Prerequisite:
BME 327 (Magnetic Resonance Imaging) or BME 325 (Introduction to Medical Imaging) advisable.

Course Description:
The course will provide a broad overview of imaging applications that are beyond simple
anatomic depiction. While MRI will be predominantly discussed modality, there will be
discussions regarding other modalities and highlight the major pros and cons with each of them.
Principles of tracer methods used in imaging, fMRI contrast mechanisms, scanning techniques,
temporal and spatial limits and both research and clinical applications will be discussed. The
concepts of molecular imaging of specific molecular events will also be presented. The lectures
by instructors and other experts from this region will be combined with students’ presentations
and discussions of current papers describing applications of the methods introduced in the
lectures. By the end of the course, students should have a fundamental knowledge of cutting-
edge functional imaging techniques and their applications in research and clinical practice.

The Canvas-based Course Management System (CMS) will be used for passing out class notes,
handouts, and announcements. Please check regularly. Recent reviews on the subjects presented
in the lectures will be provided.

Grading System:
Written Research Proposal..............................40%
Presentations (including Proposal) ...............30%
Classroom Participation..................................30%
(attendance included)
Textbooks:

Clinical Perfusion MRI: Techniques and Applications
Peter Barker, Xavier Golay, and Gregory Zaharchuk
Cambridge University Press, 2013

Introduction to Functional Magnetic Resonance Imaging Principles & Techniques
By Richard B. Buxton
Cambridge University Press, 2002

Functional MRI an introduction to methods
Edited by Peter Jezzard, Paul M. Matthews, Stephen M. Smith
Oxford University Press, 2001

Functional MRI
Edited by C.T.W. Moonen & P.A. Bandettini
Springer-Verlag, 2000

Diffusion and Perfusion Magnetic Resonance Imaging Applications to Functional MRI
Edited by Denis Le Bihan
Raven Press, 1995

Imaging Drug Action in the Brain
Edited by Edythe D. London
CRC Press, 1993

In-vivo magnetic resonance spectroscopy
Guest-editor, M. Rudin
NMR, basic principles and progress; vol 26
Springer-Verlag, 1992

Magnetic resonance spectroscopy diagnosis of neurological diseases
Else Rubaek Danielsen, Brian Ross
M. Dekker, 1999 (Galter Library)
<table>
<thead>
<tr>
<th>Date</th>
<th>Subject</th>
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<tbody>
<tr>
<td>March 31</td>
<td>Functional Imaging – more than anatomy (Prasad)</td>
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<tr>
<td>April 5</td>
<td>Perfusion-based and Flow-based functional MRI: principles, imaging techniques, applications (Prasad)</td>
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<tr>
<td>April 7</td>
<td>ASL &amp; QSM - Guest Lecturer Prof. Huan Tan, Univ. Chicago</td>
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<td>April 12</td>
<td>Neuro fMRI demo – Evanston Hospital – Dr. Doug Burman, NorthShore University HealthSystem</td>
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<td>April 14</td>
<td>PET imaging - Guest Lecturer Prof. Chin Tu Chen, Univ. Chicago</td>
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<td>April 19</td>
<td>Diffusion tensor imaging applications - Guest Lecturer Prof. Konstantinos Arfanakis, IIT</td>
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<td>April 21</td>
<td>Student paper reviews (2) - <em>Assign topics for student research proposals</em> (provide template)</td>
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<td>April 26</td>
<td>Non-neuro fMRI applications (heart, kidney, lung, etc.) (Prasad)</td>
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<td>April 28</td>
<td>Neuro fMRI applications – Guest Lecturer Prof. Todd Parrish, Northwestern</td>
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<td>May 3</td>
<td>Resting State fMRI – Guest Lecturer Prof. Todd Parrish, Northwestern</td>
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<td>May 5</td>
<td>Student paper reviews (3)</td>
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<td>May 10</td>
<td>Magnetic Nanostructures: Diagnostic and Theranostic applications – Guest Lecturer Prof. Vinayak Dravid, Northwestern University</td>
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<td>May 12</td>
<td>In-utero diffusion imaging in hypoxia-ischemia model to predict post-natal outcomes (Alex Drobyshevsky)</td>
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<td>May 17</td>
<td>Metabolic imaging: biochemical events, principles of MR Spectroscopy, intrinsic &amp; extrinsic multinuclear probes, localized MR spectroscopy techniques (single voxel, multi voxel), data analysis, applications - Guest Lecturer – Dr. Venkatasubramanian, NorthShore University HealthSystem</td>
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<td>May 19</td>
<td>Student paper reviews (2)</td>
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<td>May 24</td>
<td>Molecular imaging: principles, MRI contrast agents, scanning methods, applications (Wyrwicz)</td>
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<td>May 26</td>
<td>Student research proposal presentations (2)</td>
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<td>May 31</td>
<td>Student research proposal presentations (2)</td>
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<td>June 2</td>
<td>Student research proposal presentations (3)</td>
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<td>June 7</td>
<td>Written proposals due</td>
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<td>June 13</td>
<td>Grades due</td>
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Guest Lecturers:

Prof. Huan Tan, Ph.D.
Research Associate (Assistant Professor) of Surgery
University of Chicago
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Prof. Chin-Tu Chen, Ph.D.
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Douglas Burman, Ph.D.
Project Manager
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Prof. Konstantinos Arfanakis, Ph.D.
Associate Professor of BME
Illinois Institute of Technology
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Prof. Todd Parrish, Ph.D.
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Prof. Vinayak Dravid, Ph.D.
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