**Fundamentals of Medical Imaging: Lectures and Demonstrations**

**Fundamentals of Medical Imaging (BENG 444 / ENAS 544, MW 11:35am-12:50pm)**

 **Course objectives:**

Survey of engineering and physics of modern medical imaging modalities with an emphasis on immersive and interactive experiences.  Traditional lectures will be balanced with guest lectures on state-of-the-art techniques and opportunities to observe procedures, acquire data and reconstruct images.  Modalities include MRI, CT, SPECT, PET, optical and ultrasound methods.

**Instructors:**

Gigi Galiana, PhD (Magnetic Resonance Imaging, Optical Imaging)

Dana Peters, PhD (Magnetic Resonance Imaging, Ultrasound Imaging)

Chi Liu, PhD (X-ray, CT, and Nuclear Imaging)

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| **Lecture** |   |  |  | Assignment |
| **1** | 8/30, W | Course introduction, History of Imaging | Galiana |  |
| **2** | **9/1, *F******due to Labor Day*** | Ultrasound 1 | Peters |  |
| **3** | 9/6 W | Ultrasound 2 | Peters/Guest | HW |
| **4** | 9/11, M  | Math review | Galiana |  |
| **5** | 9/13, W | Foundations of MRI  | Peters | HW |
| **6** | 9/18, M | MRI in the clinic | Clinical radiologist (Jeff Weinreb) |  |
| **7** | 9/20, W  | Spatial encoding, making an MR Image | Galiana | HW |
| **8** | 9/25 M  | Hands on MRI 1: Phantom imaging | Peters |  |
| **9** | 9/27, W | Acceleration and reconstruction  | Galiana | HW |
| **10** | 10/2, M | Contrast mechanisms and their application to the body | Peters |  |
| **11** | 10/4 W |  Hands-on MRI 2: Human imaging | Peters |  |
| **12** | 10/9, M  | Tour of interventional Suite | TBD |  |
| **13** | 10/11 W | Optical Imaging  | Galiana  | Presentations due |
| **14** | 10/16, M | Student MRI presentations  | Peters, panel of judges  | HW |
| **---------------------------- October break 10/17-10/23 ----------------------------** |
| **15** | 10/23, M | Optical guest | Evelyn Lake |  |
| **16** | 10/25, W | **MIDTERM** | Topics: Ultrasound + MRI |  |
| **17** | 10/30, M | Nuclear physics and X-Ray systems | Liu |  |
| **18** | 11/1, W | CT systems and reconstruction | Liu | HW |
| **19** | 11/6, M | SPECT and PET systems |  Liu |  |
| **20** | 11/8, W | Machine learning in Imaging  | John Onofrey(Peters/Galiana) |   |
| **21** | 11/13, M  | PET and SPECT reconstruction and quantitative imaging | Liu | HW |
| **22** | 11/15, W | Introduction to Radiochemistry | Jason Cai |  |
|  **-------------------November break, 11/17-11/26--------------------------------** |
| **22** | 11/27 M  | Multimodality and application specific imaging | Liu |  |
| **23** | 11/29, W | State of the art & what’s next? | Liu | HW |
| **24** | 12/4, M  | PET Center Field Trip | Liu |  |
| **25** | 12/6, W | Guest lecture: SPECT and PET in clinical applications | Gabriela Spilberg |  |
|  | TBD, 12/14-12/20 | **FINAL EXAM** | Topics: Optical, CT, PET |  |

**Homework problems** are posted on Monday or Wednesday by 5pm and are due one week later (corresponding Mon or Wed at 5pm). Homework can be handed in or submitted on canvas. Collaborative discussion about homework is encouraged, but assignments should be completed independently.

 **Determination of grades:**

8 homework sets: 5% each (40% total).

1 presentation: 10%

2 exams: 25% each (50% total)