ROC 7160: Advanced Imaging

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Time: Tuesday 4:00-6:00pm

Office Hours: Tuesday 2:00-4:00pm or by appointment

Course location: Gershenson Radiation Oncology Center, Large Conference Room

Course Description and objectives:

Part I:
Description: This part of the course will serve as an overview of the image and data analysis techniques widely used in Radiology and Radiation Oncology. For each topic, I will introduce the techniques, the academic/clinical usage, the possible new approaches and the related software in the market. I will also try to demonstrate the process of implementing applied research (find the problem-> scientific analysis->proposing a solution->implementation and experimentation->evaluation) in general. This part of the course will require you to implement methods/techniques using computer software.

Objectives:
   a) Discuss the importance of image registration in radiation therapy
   b) Discuss the importance of image segmentation in radiation therapy
   c) List the benefits of Adaptive radiotherapy and the image modalities involved.
   d) List the benefits of motion management methods
   e) Discuss “what does programming mean to a medical physicist”

Part II:
Description: This portion of the course will cover fundamentals of the predominant x-ray imaging modalities used in radiation therapy for planning and treatment delivery, with some discussion of future advances. We will also have a comprehensive review of what is meant by image quality, and how it is measured. The basic linear model description of radiographic imaging systems will be presented.

Objectives - be able to discuss:
   a) Image quality descriptors and measurement techniques
   b) The linear model
   c) CT reconstruction basics
   d) Muti-detector CT functionality
   e) Management of respiration in treatment delivery
   f) Imaging at the linac for patient setup and treatment guidance
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<td>Jan 13</td>
<td>Introduction</td>
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<td>Jan. 20</td>
<td>Image representation and basic image manipulation</td>
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<td>Jan. 27</td>
<td>Feature detection and image segmentation</td>
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<td>Feb. 3</td>
<td>Image registration</td>
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<td>Feb. 10</td>
<td>Data representation and data analysis</td>
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<td>Feb. 17</td>
<td>Advanced image applications in radiation therapy</td>
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<td>March 3</td>
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<td>CT Reconstruction</td>
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<td>Multi-detector CT</td>
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<td>April 7</td>
<td>Dual Energy CT, Photon Counting</td>
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<td>April 14</td>
<td>Respiratory Management in Radiation Therapy</td>
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<td>April 21</td>
<td>Linac-based Radiotherapy Image Guidance</td>
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<td>Presentation week</td>
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**Grading:**

1. Presentation (20%)
   a. 10% class presentation.
   b. 10% slides preparation, please send the slides one week early for review. Otherwise, lower score may occur.
   c. Comments and score will be given during class.
   d. Presentation should include 10 to 20 slides and at least 10 references. Presentation time should not exceed 20 minutes, followed by a 2 minute question/discussion time.
   e. Extra points will be given if you provide a scientific report on the topic you pick (minimum 2 pages).

2. Project (40%)
   a. It is due on May. 5th. Each day thereafter will result in 10% reduction of the full mark.
   b. You can use Matlab, C++, C# or any programming language you are comfortable with.
   c. You can discuss the project with others, but you must write it yourself. You may identify collaborators in the report.
   d. Assignment requires both a softcopy and a hardcopy.
   e. Comments within the code and discussion of the results are required.

3. Homework (40%)
   a. Problem-solving homework assignments will be given in Part 2.

**Course Materials:**

1. Lecture Notes
3. Part 2 material will be posted to the Blackboard.