Fall 2022
Imaging System Analysis
ENU 5658; Section 1D03; 3 Credits

CLASS MEETING INFO
11:45a-1:00p (Tu, Th)
C2-33, Communicore

INSTRUCTOR
David Gilland; gilland@ufl.edu; 265-0293
Office Hours: email for appointment

TEACHING ASSISTANTS
Zahra Mojabi (zmoj0001@radiology.ufl.edu)

DESCRIPTION
This course covers imaging systems analysis from a linear systems perspective with an emphasis on radiological imaging. Topics covered include the following: convolution, point spread function, modulation transfer function, Fourier Transform, linear filtering, sampling theory, image reconstruction from projections, image noise and image quality evaluation. 3 credit hours

PRE-REQUISITES/CO-REQUISITES
Calculus 1-3 (MAC2311, MAC 2313 and MAC 2313) or equivalent

OBJECTIVES
• Develop in depth understanding of fundamental mathematics used to analyze radiological imaging systems.
• Develop skills to apply theoretical analysis in practice using software tools.
• Understand fundamental issues in radiological image quality evaluation.
• Develop skills to evaluate and present results of original research papers.

MATERIALS AND SUPPLY FEES – N/A

REQUIRED TEXTBOOKS & SOFTWARE
A. Title: The Essential Physics of Medical Imaging
   Author: J.T. Bushberg
   Publication date and edition: 2021, 4th edition
   ISBN number: 978-1-4511-1810-0
B. Matlab (available at apps.ufl.edu)
Additional reading will be assigned from:
- Barrett and Swindell, *Radiological Imaging*
- Castleman, *Digital Image Processing*
- Macovski, *Medical Imaging Systems*
- research articles distributed in class.

**RECOMMENDED MATERIALS -- N/A**

**COURSE SCHEDULE**

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Reading</th>
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<tr>
<td>1</td>
<td>digital image display, image file formats</td>
<td>Bush: Ch.1, 4.2.3</td>
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<td>2</td>
<td>Linear Systems Theory in Medical Imaging</td>
<td>B&amp;S: 2.1-2.2, App. A.1</td>
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<td>3</td>
<td>Spread functions, convolution</td>
<td>B&amp;S: 4.1-4.1.3, App. G</td>
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<td>B&amp;S: 2.3, App. B.1-B.4</td>
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<td>4</td>
<td>Sinusoid input, MTF, Convolution Theorem</td>
<td>Bush: 4.1.4</td>
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<td>5</td>
<td>Linear filters, Fourier Transform</td>
<td>Bush: App. G</td>
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<td>B&amp;S 2.4</td>
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<td>6</td>
<td>Fourier Transform (cont.)</td>
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<td>7</td>
<td>Sampling Theory</td>
<td>Bush: 4.1.4, App. G</td>
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<td>B&amp;S 2.5; Castle 12.1-12.2</td>
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<tr>
<td>8</td>
<td>Quiz 1</td>
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<td>9</td>
<td>Spatial resolution in x-ray imaging</td>
<td>Bush: 7.1; B&amp;S 4.1, 4.3</td>
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<td>10</td>
<td>Image reconstruction: CST, FBP</td>
<td>Bush: 10.4; Macovski: pp. 114-129</td>
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<td>11</td>
<td>Image recon (cont.): iterative methods</td>
<td>Bush: 10.4.7; Bruyant (2002)</td>
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<td>12</td>
<td>Noise in radiological images</td>
<td>Bush: 4.3, 4.4</td>
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<td>13</td>
<td>Image quality evaluation, ROC</td>
<td>Bush: 4.4, 4.5</td>
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<td>14</td>
<td>Student paper presentations</td>
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<tr>
<td>15</td>
<td>Quiz 2</td>
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**ATTENDANCE POLICY; CLASS EXPECTATIONS; MAKE-UP POLICY**

- On time class attendance and participation in class discussions are expected.
- Material will be presented during class that will not be available electronically but will be necessary for homework assignments and exams. Therefore, note taking is highly encouraged. If a class is missed, arrangements should be made to get the notes from a classmate.
- Requirements for class attendance and make-up exams, assignments, and other work are consistent with university policies that can be found at: [https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx](https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx)
- Excused absences must be consistent with university policies in the Graduate Catalog and require appropriate documentation: [http://gradcatalog.ufl.edu/content.php?catid=10&navoid=2020#attendance](http://gradcatalog.ufl.edu/content.php?catid=10&navoid=2020#attendance)
EVALUATION OF GRADES
60% Problem sets/presentations
20% Quiz 1
20% Quiz 2

GRADING POLICY

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<thead>
<tr>
<th>Percent</th>
<th>Grade</th>
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<tr>
<td>93-100</td>
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<td>90-92</td>
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<td>87-89</td>
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<td>60-62</td>
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<td>59 &amp; below</td>
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More information on UF grading policy may be found at:
http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades

STUDENTS REQUIRING ACCOMMODATIONS
Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565; https://www.dso.ufl.edu/drc) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

COURSE EVALUATION
Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at gatorevals.aa.ufl.edu/public-results/.

UNIVERSITY HONESTY POLICY
UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor
received unauthorized aid in doing this assignment.” The Honor Code (https://www.dso.ufl.edu/scr/process/student-conduct-honor-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

SOFTWARE USE
All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

STUDENT PRIVACY
There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html

IN CLASS RECORDING POLICY
Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student

CAMPUS RESOURCES

Health and Wellness
**U Matter, We Care**

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

**Counseling and Wellness Center**

352-392-1575; [http://www.counseling.ufl.edu/cwc](http://www.counseling.ufl.edu/cwc)

**Sexual Assault Recovery Services (SARS)**

352-392-1161; Student Health Care Center

**University Police Department**

352-392-1111 (or 911 for emergencies); [http://www.police.ufl.edu/](http://www.police.ufl.edu/)

**Academic Resources**

**E-learning Technical Support**

352-392-4357 (select option 2); learning-support@ufl.edu; [https://iss.at.ufl.edu/help.shtml](https://iss.at.ufl.edu/help.shtml)

**Career Resource Center**

Career assistance and counseling.
352-392-1601; Reitz Union; [https://www.crc.ufl.edu/](https://www.crc.ufl.edu/)

**Library Support**

Various ways to receive assistance with respect to using the libraries or finding resources.
[http://cms.uflib.ufl.edu/ask](http://cms.uflib.ufl.edu/ask)

**Teaching Center**

General study skills and tutoring.
352-392-2010 or 352-392-6420; Broward Hall; [https://teachingcenter.ufl.edu/](https://teachingcenter.ufl.edu/)

**Writing Studio**

Help brainstorming, formatting, and writing papers.
352-846-1138; 302 Tigert Hall; [https://writing.ufl.edu/writing-studio/](https://writing.ufl.edu/writing-studio/)

**Student Complaints Campus**


**On-Line Students Complaints**

[http://www.distance.ufl.edu/student-complaint-process](http://www.distance.ufl.edu/student-complaint-process)