

Fall 2021

**Imaging System Analysis**

ENU 5658; Section 1D03; 3 Credits

**CLASS MEETING INFO**

3:00p-4:15p (Tu), 1:00p-2:15p (Th)  
C2-33, Communicore

**INSTRUCTOR**

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

**TEACHING ASSISTANTS**

N/A

**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: 2012, 3<sup>rd</sup> 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

<b>Week</b>	<b>Topic</b>	<b>Reading</b>
1	digital image display, file formats	Bushberg Ch.1, 5.5
2	Linear Systems Theory in Medical Imaging	B&S: 2.1-2.2, Appendix. A.1
3	Convolution, point spread function	B&S: 2.3, App. B.1-B.4, Bushberg 4.1-4.3
4	Sinusoid input, MTF, Convolution Theorem	Bushberg 4.4
5	Linear filters, Fourier Transform	B&S 2.4
6	Fourier Transform (cont.)	
7	Sampling Theory	B&S 2.5, Castleman 12.1-12.2, Bushberg 4.4
8	Exam 1	
9	Application: spatial resolution in x-ray imaging	Bushberg 7.1, B&S 4.1, 4.3
10	Image reconstruction: CST, FBP	Bushberg: 10.4, Macovski: pp. 114-129
11	Image recon (cont.): iterative methods	Brooks & DiChiro, Bruyant (2002)
12	Noise in radiological images	Bushberg: 4.5, 4.6, 4.11
13	Image quality evaluation, ROC	Bushberg 4.12, Metz (1978)
14	Student paper presentations	
15	Exam 2	

## 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>
- Excused absences must be consistent with university policies in the Graduate Catalog and require appropriate documentation:  
<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance>

## EVALUATION OF GRADES

- 60% Homework/presentations
- 20% Quiz 1
- 20% Quiz 2

## GRADING POLICY

Percent	Grade
93-100	A
90-92	A-
87-89	B+
83-86	B
80-82	B-
77-79	C+
73-76	C
70-72	C-
67-69	D+
63-66	D
60-62	D-
59 & below	E

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/](http://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/](http://ufl.bluera.com/ufl/). Summaries of course evaluation results are available to students at [gatorevals.aa.ufl.edu/public-results/](http://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/sccr/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](mailto: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>

### **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/>

### **Academic Resources**

#### **E-learning Technical Support**

352-392-4357 (select option 2); learning-support@ufl.edu; <https://lss.at.ufl.edu/help.shtml>

#### **Career Resource Center**

Career assistance and counseling.

352-392-1601; Reitz Union; <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>

#### **Teaching Center**

General study skills and tutoring.

352-392-2010 or 352-392-6420; Broward Hall; <https://teachingcenter.ufl.edu/>

#### **Writing Studio**

Help brainstorming, formatting, and writing papers.

352-846-1138; 302 Tigert Hall; <https://writing.ufl.edu/writing-studio/>

#### **Student Complaints Campus**

[https://www.dso.ufl.edu/documents/UF\\_Complaints\\_policy.pdf](https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf)

#### **On-Line Students Complaints**

<http://www.distance.ufl.edu/student-complaint-process>