On-campus Students:
Time 8:00 – 9:15
This class is scheduled to be taught in the LIVE ONLINE modality

Distance Ed Students:
Access lecture video recordings through Content page of D2L

Dr. Donald Bruyere
dbruyere@email.arizona.edu
Office Hours: Tu/Th 10:00 am to 11:30 am or By Appointment

Rodger Elkins
rhelkins@email.arizona.edu
Office Hours: By Appointment

Robert (Bob) Lepore
rglepore@email.arizona.edu
Office Hours: By Appointment

Course Description:

Provide students with a system level understanding of sensor development. The student will see the development of remote sensing techniques beginning with high level requirements through concept of operations, architecture development, subsystem modeling and culminating in integration, validation and verification. The student will be exposed to key design parameters for radar and Electro Optical sensing systems that drive both system cost and performance. Advanced multi-sensor systems and adaptive signal processing will also be discussed.

Course Prerequisite(s):
PHYS 241, SIE 305, or consent of instructor and Advanced Standing

Instructor and Contact Information:
Dr Donald Bruyere   dbruyere@email.arizona.edu

Rodger Elkins   relkins@email.arizona.edu

Bob Lepore   rglepore@email.arizona.edu

Teaching Assistant: None

Course Format and Teaching Methods:
This course is lecture based. This class will use web-based D2L (Desire to Learn) as the only means of distributing class materials including assignments. All homework assignments and a culminating project will be submitted by the student into Assignment Submission Folders on D2L before the appropriate due dates. **No late assignments will be accepted.** Your grades for this course will also be available on D2L. You will need a UANet ID to access D2L at the following site: http://d2l.arizona.edu/. You are expected to check D2L frequently for class information

Course Objectives and Expected Learning Outcomes:
Upon completion of this course **Undergraduate and Graduate** students will understand the foundations, principles, methods and tools for effective design of a system employing multi-spectral (radar & electro-optical) sensors, including:

- Multi-spectral sensor Concept of Operation (CONOPS) development
- Sensor requirements allocation and derived requirement development
- Sensor Architecture development
- Hardware and software partitioning
- Functional and physical interface requirements and design
- Signal processing requirement definition
- Subcomponent performance modeling and testing
- Observable measurement definition (range, range rate, angle, etc)
- Key sensor design trade parameters
- Multi-spectral sensor systems design methodology
- Modern target tracking techniques

In addition, **Graduate** students will learn:
- Image deblur/restoration techniques
- Image analysis techniques
- Adaptive signal processing

Upon completion of the course all students will be able to demonstrate the following Learning Outcomes:
- Students will be able to construct sensor models and allocate requirements to sensor components
- Students will understand how to verify sensor system performance
- Students will be able to identify practical, cost effective sensor solutions to solve real world problems

Upon completion of the course graduate students will be able to demonstrate the following additional Learning Outcomes:
- Students will understand how to differentiate between data processing techniques to track and/or recognize objects provided by the sensor(s)
- Students will be able to define data processing requirements for sensor systems

Absences and Class Participation Policy:

The UA's policy concerning Class Attendance, Participation, and Administrative Drops is available at: http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop

The UA policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable, http://policy.arizona.edu/human-resources/religious-accommodation-policy.

Absences pre-approved by the UA Dean of Students (or Dean Designee) will be honored. See: https://deanofstudents.arizona.edu/absences

Participating in the course and attending lectures and other course events are vital to the learning process. Students are responsible for all materials covered during class. As such, attendance is strongly recommended. Occasionally, attendance may be required for special events such as Project Presentations. Students who miss class due to illness or emergency are required to bring documentation from their health-care provider or other relevant, professional third parties. Failure to submit third-party documentation will result in unexcused absences.

Class Guidelines:

All students:
- Check D2L regularly.
- Turn-in assignments by due date/time (allow for D2L "glitches").
- Treat instructors, speakers and peers with respect.
- Always behave in an ethical manner.
- Students are encouraged to use laptops for note taking and other class activities.

On-campus students:
- Arrive on-time, turn off cell phones, beepers, social networks, etc.
- Attend class regularly and participate in class discussions and activities.

Distance Ed students:
- View lectures in a timely manner, preferably within 48 hours of the lecture date.
- In some cases, Content will be developed "For Distance Ed Students Only". Pay careful attention to all communications.
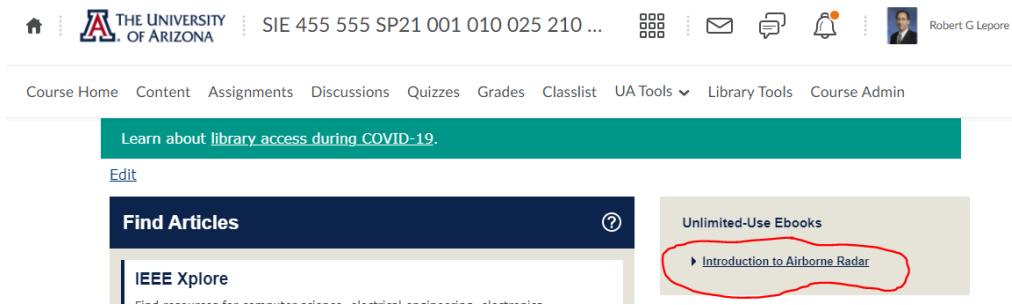
Grad students:
- In some cases, Content will be developed "For Grad Students Only". Pay careful attention to all communications.

Course Communication:

D2L will be used for normal course communication. Both D2L and UA e-mail will be used for any critical items.

Required Text:

- *Introduction to Airborne Radar* by George W. Stimson. Second Edition is current. First or second addition are acceptable. ISBN-13: 978-1891121012.
  - The UA Libraries are pleased to provide your students with free access to the following unlimited-user ebook, see D2L Under Library Tools

- *RCA Electro-Optical Handbook* by RCA. Will be provided.
- *A Tutorial on Electro-Optical/Infrared (EO/IR) Theory and Systems.* Will be provided.

Required Materials:

Laptop with MATLAB required.

Required Extracurricular Activities:

None

Assignments and Examinations:

The course will have weekly assignments consisting of online D2L quizzes. There will be two Midterm Exams and a Final Exam. In addition, a team Project will be due. The Project will have additional components for Graduate students.

Class Project:

All students will be required to complete a class project. The project will be presented in class. Students will be able to present using the Zoom tool.

Graduate students will be required to do additional analyses using MATLAB or other tools

Examinations:

Since we will be conducting this class Live Online you have two choices for taking the exams.

- **Option 1** is that we will conduct a normal Zoom session and we will monitor you as you take the exam. Your video will need to be on the whole time so that we can observe you. This option may be simpler for students not interested in following the Examity restrictions. This Option may be better for DRC students also as we can easily extend the test window to accommodate exceptions.
- **Option 2** is that you can take the exam using The University of Arizona's online exam partner – Examity. Examity has very strict rules to follow but will give you the flexibility of taking the test during non-class hours for those students not in Arizona. Since Examity cannot handle everyone taking the exam at the same time

there will be a 48-hour window to take the exam. The Examity rules are summarized in the next section.

Introduction to Examity:
In this class, you may take your tests remotely and they will be proctored by a service called **Examity**. A Student Quick-Guide will be provided on how to use Examity.

Before you can begin proctored assessments, you must sign up for an Examity account. This requires two steps:

1. Access the Examity system through our class' D2L course site by clicking the Examity link found within your course content. This link will direct you to the Examity dashboard.

2. From your Examity dashboard, setup a profile. You will need to
    1. upload a CatCard or Government ID (State Driver's License or Identification Card)
        1. you will need to bring this same ID with you each time you take a text with Examity
    2. answer three security questions
    3. enter a keystroke biometric signature
    4. select your time zone
    5. and confirm your name, email address, and phone number

Before scheduling and taking your assessment, please review these Examity System Requirements

- A testing space.
    - One of Examity's standard rules requires students to test in room, by themselves and from a workspace cleared of all non-test materials, preferably at a clear desk or table workspace. If you choose to test in other environments such as the floor or bed, you may be subject to a more thorough search during the authentication process
- Desktop computer or laptop (not tablet or phone)
- Webcam and microphone (built-in or external)
- Connection to network with internet speed of at least 2Mbps (upload and download)
- Operating system of Windows XP – Windows 10, Mac OS X 10.8 – 10.11
- Browser with pop-up blocker disabled – Google Chrome v39 or later, Mozilla Firefox v34 or later, Internet Explorer v8 or later, Microsoft Edge, Apple Safari v6 or later

If you have any questions or concerns, contact Examity's technical support team 24/7 via email at **support@examity.com (link sends e-mail)** or by phone at **(855)-392-6489**.

Grading Scale and Policies:
The grade for this course will be determined as follows:
25% Final Exam   Thursday, May 13th (8:00 am to 10:00 am)
30% Midterms (2 midterms - 15% each)
        Radar Midterm   Thursday, February 18th

Electro-Optical Midterm   Thursday, April 1st
20% Project
20% Assignments (Quizzes)
 5% Collaboration

Final Grades for this course will be computed as follows:

>90%   A
>80%   B
>70%   C
>60%   D
<60%   E

Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, which are available at http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete and http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal respectively.

Honors Credit:
Honors Credit will not be available at this time.

Scheduled Topics/Activities:
The Class Schedule is available on D2L. It lists all material to be covered by date and includes references to assigned reading (also included on D2L). All assignments are listed with their respective due dates. **Note that the Assignment Submission Folder for each assignment will remain open only until 11:59 PM the day the assignment is due.**

All homework/projects/presentations and papers are to be submitted by the due date/time to the D2L Assignment Submission Folder unless otherwise specified. All D2L activities, including Discussions, Surveys and Quizzes, must be complete by the due date/time. No late work is accepted. No extra credit is available.

The following details the class topics and assignment due dates.

Classroom Behavior Policy:
To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, chatting, reading a newspaper, making phone calls, web surfing, etc.).

Threatening Behavior Policy
The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. See http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students.

Accessibility and Accommodations:

At the University of Arizona, we strive to make learning experiences as accessible as possible. If you anticipate or experience barriers based on disability or pregnancy, please contact the Disability Resource Center (520-621-3268,

https://drc.arizona.edu/) to establish reasonable accommodations.

If you have DRC accommodations for the exams let us know so we can adjust D2L and Examity accordingly.

Code of Academic Integrity

Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See: http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity.

The University Libraries have some excellent tips for avoiding plagiarism, available at http://www.library.arizona.edu/help/tutorials/plagiarism/index.html.

Selling class notes and/or other course materials to other students or to a third party for resale is not permitted without the instructor's express written consent. Violations to this and other course rules are subject to the Code of Academic Integrity and may result in course sanctions. Additionally, students who use D2L or UA e-mail to sell or buy these copyrighted materials are subject to Code of Conduct Violations for misuse of student e-mail addresses. This conduct may also constitute copyright infringement.

UA Nondiscrimination and Anti-Harassment Policy

The University is committed to creating and maintaining an environment free of discrimination; see http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy

Our classroom is a place where everyone is encouraged to express well-formed opinions and their reasons for those opinions. We also want to create a tolerant and open environment where such opinions can be expressed without resorting to bullying or discrimination of others.

Additional Resources for Students:

UA Academic policies and procedures are available at http://catalog.arizona.edu/policies

Student Assistance and Advocacy information is available at http://deanofstudents.arizona.edu/student-assistance/students/student-assistance

Confidentiality of Student Records

All student records are held in strict confidence. Additional information can be found at http://www.registrar.arizona.edu/personal-information/family-educational-rights-and-privacy-act-1974-ferpa?topic=ferpa

Subject to Change Statement:

Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.