

**On-campus Students:**  
**Time 8:00 – 9:15**  
**C E Chavez, Room 103**

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

**Dr. Donald Bruyere**  
[dbruyere@email.arizona.edu](mailto:dbruyere@email.arizona.edu)  
Office Hours: MW 2:30 to 4:00 PM via Zoom

**Rodger Elkins**  
[rhelkins@email.arizona.edu](mailto:rhelkins@email.arizona.edu)  
Office Hours: **TBD**

**Robert (Bob) Lepore**  
[rglepore@email.arizona.edu](mailto:rglepore@email.arizona.edu)  
Office Hours: **TBD**

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### **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@arizona.edu](mailto:dbruyere@arizona.edu)

Rodger Elkins      [relkins@arizona.edu](mailto:relkins@arizona.edu)

Bob Lepore      [rglepore@arizona.edu](mailto:rglepore@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 or watching Panopto/Zoom video is strongly recommended. Occasionally, attendance may be required for special events such as Project Presentations (may be via Zoom). 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.

**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. Distance 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:**

There are two Midterm exams and a Final exam. The Final Exam is scheduled for Thursday, May 9th from 8:00 to 10:00 in the regular classroom. The Final Exam is required. See the class schedule for Midterm exam dates. Note: attendance at the exams is required for on-campus students unless special arrangements are made. Online students will need to take exams via Zoom, generally the weekend before the in class exam. We will provide additional details regarding exams and Zoom dates in class. The Final Exam Regulations can be found at <https://www.registrar.arizona.edu/courses/final-examination-regulations-and-information>, and Final Exam Schedule can be found at <http://www.registrar.arizona.edu/schedules/finals.htm>

**Grading Scale and Policies:**

The grade for this course will be determined as follows:

- 25% Final Exam
- 30% Midterms (2 midterms - 15% each)
  - Radar Midterm
  - Electro-Optical Midterm
- 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.

**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.