Course Number and Title

OPTI 613– Infrared Systems

Course Description

This course provides the background, theory, and practice of how to design, analyze, and test high performance infrared imaging systems. The course is presented in three sections. The first section provides a brief review of the basic mathematics, radiometry, and diffraction theory needed to be successful in imaging system performance calculations. The second section includes a detailed look at all the components that make up an electro-optical or infrared imaging system to include targets, atmospherics, optics, detectors, electronics, signal and image processing, displays and the human visual system. The student is taught how to calculate the component resolution (modulation transfer function) and sensitivity for each of the components. Modulation Transfer Functions and optical throughput along with signal-to-noise is determined for each imaging system component. The student is taught how to determine whether a system is turbulence-limited, detector-limited, diffraction or aberration-limited, display-limited, or human vision system limited. The third section teaches the student how to combine all the component transfer functions and throughput (with infrared radiation) to determine the imaging system contrast threshold function. This system CTF is used in the design of imaging systems to accomplish some object discrimination task (e.g., detection, recognition, or identification). System theory, laboratory performance, and field performance are covered. These concepts apply to both infrared and electro-optical imaging system performance.

Instructor Information

Instructor Name: Ronald Driggers

Title: Professor

Contact Information: College of Optical Sciences
Office 437
Meinel Bldg
1630 E University Blvd, Tucson, AZ 85721

Phone: 407-669-6958

Course Hours: Mon, Wed 9:00am – 10:15pm

Office Hours: Will stay around after class for a half hour or by appt

Learning Outcomes

This is a graduate level course. After this course, students will be expected to be experts in radiometry and know how to convert quantities quickly (e.g., radiance to intensity). At the end of this course, students will be expected to analyze an existing electro-optical or infrared imager as well as design an electro-optical or infrared imager. Students will be required to calculate all component level performance metrics (e.g., detector angular subtense, optical modulation transfer function, human visual contrast threshold function, etc.) More importantly, students will be required to quickly determine whether an imager is diffraction-limited, detector-limited, sampling-limited, turbulence-limited, etc. Students will be required to design an infrared imager that can identify human activities at 10 kilometers range under given conditions. Students will be required to analyze a given infrared imager and make improvements to the system performance.

400/500 Co-convened Course Information

Prerequisite of background in Fourier Transforms, Linear Systems, OPTI 512R or equivalent.

Required Texts and Materials

Introduction to Infrared and Electro-Optical Systems, 2nd Edition, Artech House

Schedule of Topics and Activities

- Introduction
- Mathematics Review
- Linear Shift Invariant Systems Review
- Diffraction Review
- Sources of Radiation
- In-Class Closed Book Test
- Atmospherics
- Optics
- Detectors
- Electronics
- Image Processing
- Displays and Human Perception
- In-Class Open Book Exam
- MTF and NETD
- Historical Performance Models Hand out analysis/design test

- CTF and the Target Task Performance Metric
- Electro-Optical and Infrared System Performance
- Simple Modeling and Pilotage
- Laboratory Measurements of Infrared Systems
- NVTherm Tutorial — Hand in Analysis/Design test
- Final Exam — Sign up previously

Assessments

Assessment	Percent of Final Grade
Exam 1:	**25%**
Exam 2:	**25%**
Exam 3:	**25%**
Homework and/or Design/Analysis Problem	**25%**
Total Grade	**100%**

Grading Scale and Policies

Grading Scale (%)	
94-100	A
90-93	A-
87-89	B+
84-86	B
80-83	B-
77-79	C+
74-76	C
70-73	C-
67-69	D+
64-66	D
60-63	D-
0 – 59	F

Late Work Policy:
There are no make-ups for in-class tests, or the final oral exam. Arrangements due to conflicts need to be worked out with me prior to the test(s) and will likely occur on campus. Take home assignments will be assigned with plenty of time to complete, and will not be accepted late.

Extra Credit Policy:
Generally, there is no extra credit.

University Policies

All university policies related to a syllabus are available at: https://academicaffairs.arizona.edu/syllabus-policies. By placing this link in your syllabus, you no longer need to have each individual policy includedin your syllabus.

Subject To Change Notice

Information contained in the course syllabus, other than the grade and absence policies, may be subjectto change with reasonable advance notice, as deemed appropriate by the instructor of this course.

Graduate Student Resources (optional)

Please consider including a link to the University of Arizona's Basic Needs Resources page: http://basicneeds.arizona.edu/index.html