Introduction to Imaging Sensors

Fall 2008 SYLLABUS

Instructor: Dr. Ravindra Athale, Principal Scientist, Emerging Technologies Office, MITRE Corporation, McLean, VA.

Prerequisites: ECE 305, ECE 430

Credits: 3

Course Time: Tuesday; 19:20 – 22:00

Course Description:
Imaging sensors are being used extensively in defense, homeland security, biomedical, scientific and consumer applications. This course provides introduction to the operating principles of the front end optics and sensor technologies. In addition to the familiar cameras, the course will also discuss advanced microscopy, medical imaging (tomography, MRI) and radar imaging systems.

Lecture Content:

- **Lecture 1**: Course overview. Historical background, major milestones in imaging.
- **Lecture 2**: Ray optics. Refraction. Simple lens/mirror imaging. Lens equation.
- **Lecture 3**: Aberrations – origin and corrections. Advanced lens systems.
- **Lecture 4**: Wave propagation and image formation. Diffraction and interferences.
- **Lecture 5**: Fourier analysis approach to image formation.
- **Lecture 6**: Recording of images – principles of photographic film
- **Lecture 7**: MIDTERM 1 (1/2 lecture). Intro to Semiconductor Device.
- **Lecture 8**: Electronic image recording technology. Vidicons, CCD, CMOS.
- **Lecture 9**: Infrared focal plane array technologies.
- **Lecture 10**: Consumer digital camera roadmap
- **Lecture 11**: MIDTERM 2 (1/2 lecture). Microscopy
- **Lecture 12**: Telescopes (Hubble, James Webb Space Telescope, Adaptive Optics).
- **Lecture 13**: Medical imaging (Computer Tomography, MRI, Ultra-sound)
- **Lecture 14**: Imaging radars (Synthetic Aperture Radar, Very Large Array Telescope)
- **Lecture 15**: Project presentations.

Homework:
Homework will be assigned every week. The nature of the homework will be to provide students with a quantitative feel for the concepts discussed in the class. Homework will not be very difficult but will test the diligence and work put in by students.

Project:
Projects will be individual projects (not group projects) and will consist of literature search and a short report plus class room presentations.

Exams:
- There will be a midterm exam after the first two units. Final exam will include some basic concepts from the first two units but will be concentrated on the last part. The mid-terms will have two parts – conceptual part (closed notes, closed books) and application of concepts part with open book.
Grades:
  Homework (25), Projects (10), Midterms (30), Final Exam (35)

Required Texts:  NONE
Lecture notes; Web resources