Course Title: Optical imaging system design
Course Number: ECE595

Instructor: Meng Cui

The course will be offered in the **spring semester of odd years**.

Course Description: The goal is to have our students thoroughly understand the process of optical system design and acquire the skills to carry out practical optical system design using widely used commercial design software (e.g. Zemax). This course will start with an overview of modern imaging systems and the introduction of the background knowledge points required for imaging system design. Next, we will provide systematic training for using the ray-tracing software (Zemax, Code V) to carry out practical imaging system design. The learning process involves both a theoretical understanding of the aberration of the imaging system and how to leverage design software to control and suppress the system aberration. To convert the basic design model to practical systems, we will discuss the practical aspects of imaging system design including the tolerance analysis, optomechanical integration, and the calibration and testing of imaging systems. Next, we will utilize these fundamental skills to analyze and design practical imaging solutions including camera systems and microscopic imaging systems. Finally, we will discuss the wave propagation method for analyzing high numerical aperture imaging systems. A key aspect of this course is to promote learning through doing. Hands-on experience in using the software for the design and analysis of imaging systems will be the essential component for students to understand the theory and the practice of imaging system design. The course has no exams. The total grade depends on the quality of the 9 design projects carried out over the semester.

Textbook

- 1. R. R. Shannon, The art and Science of Optical Design
- 2. Kingslake-Johnson, Lens Design Fundamentals
- 3. José Sasián, Introduction to Lens Design
- 4. John Greivenkamp, Field guide to geometrical optics
- 5, Julie Bentley, Field Guide to Lens Design

Course syllabus

- Week 1 Overview of imaging system design
- Week 2 Fundamentals of imaging system
- Week 3 Fundamentals of lens design program
- Week 4-5 The aberration of imaging systems
- Week 6-7 The control of system aberration
- Week 8-9 Lens optimization
- Week 10 Tolerance analysis
- Week 11 Imaging system integration
- Week 12 Calibration and testing of imaging system
- Week 13 The design of macroscopic imaging system
- Week 14 The design of microscopic imaging system
- Week 15 Wave propagation method

Grading info

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