OPTI 415 Overview

OPTI 415 is an engineering course that is designed to unite concepts from several geometrical and physical optics courses. The goal of the class is to provide understanding of the requirements for specifying optical elements, fabricating the parts and evaluating the performance of the delivered part.

Instructor
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Course Web Site
https://wp.optics.arizona.edu/visualopticslab/courses/opti-415r-optical-specifications-fabrication-and-testing/

Tests (Take Home/Open Notes)

Midterm	TBD, end of March/Early April
No Final Exam	

Grading

Homeworks	33% (approximately 8 homeworks)
Midterm	33%
Final Project	34% (Due last day of class)

Homework grades will be decreased by 10% for each day they are late.

Teaching Assistants
Josh McDonald
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Office Hours: No specific office hours. Coordinate with the TA and the instructor through email to arrange meeting times to answer questions regarding the course material.

Required Texts
Schwiegerling J. *Optical Specification, Fabrication and Testing*. (SPIE, Bellingham, WA, 2014). This text was written specifically for this class and contains a much more descriptive and neater overview of the course material than the lecture notes.

Additional Suggested References
Fischer RE, Tadic-Galeb B, Yoder PR. *Optical System Design, 2nd ed*. (Mcgraw-Hill, New York, 2008).
Malacara D. *Optical Shop Testing, 3rd ed.* (Wiley, New Jersey, 2007).
Smith W. Modern Optical Engineering, 4th ed. (Mcgraw-Hill, New York, 2008).

Outline

1. Properties of Optical Systems
    1.1. Optical Properties of a Single Spherical Surface (Brief Review)
        1.1.1. Refractive Surface: Radius, Curvature, Focal Length and Power
        1.1.2. Reflective Surface: Focal Length and Power
        1.1.3. Gaussian Imaging Equation
        1.1.4. Newton's Equation
    1.2. Aperture and Field Stops (Brief Review)
        1.2.1. Aperture Stop Definition
        1.2.2. Marginal Ray
        1.2.3. Chief Ray
        1.2.4. Vignetting
        1.2.5. Field Stop Definition
            1.2.5.1. Image Sensor as Field Stop
                1.2.5.1.1. Standard CCD/CMOS sensor dimensions
    1.3. First Order Properties of an Optical System (Brief Review)
        1.3.1. Gaussian Reduction (Conceptually)
        1.3.2. ynu raytrace
        1.3.3. Cardinal Points
        1.3.4. Entrance and Exit Pupils
        1.3.5. Extension of Gaussian Imaging to Thick Systems
        1.3.6. Transverse and Longitudinal Magnification
        1.3.7. Lagrange invariant, Etendue, Throughput, AΩ Product
        1.3.8. F-Number, Working F-Number and Numerical Aperture
        1.3.9. Depth of Field
        1.3.10. Field of View
        1.3.11. Front and Back Focal Distances
            1.3.11.1. Standard Flange distances for cameras
    1.4. Measurement of First Order Properties of Optical Systems
        1.4.1. Measurements based on Gaussian Imaging Equation
        1.4.2. Autocollimation Technique
        1.4.3. Neutralization Test
        1.4.4. Focimeter
        1.4.5. Focal Collimator
        1.4.6. Reciprocal Magnification
        1.4.7. Nodal-Slide Lens Bench
    1.5. Diffraction and Aberrations
        1.5.1. Black Box Optical System based on Cardinal Points and Pupils.
        1.5.2. Wavefront Picture of Optical Imaging
        1.5.3. Diffraction-Limited Systems and Connection to Fresnel Diffraction
        1.5.4. Point Spread Function (PSF) calculation and dimensions
        1.5.5. Sign and Coordinate System Conventions
        1.5.6. Optical Path Length (OPL), Optical Path Difference (OPD), Wavefront Error
        1.5.7. Transverse Ray Error and Spot Diagrams
        1.5.8. Aberrations of Rotationally Symmetric Optical Systems
            1.5.8.1. Piston and Tilt