

OPTI 596C- Aberrated Imaging and Propagation

Course Description:

Diffraction effects of aberrations in imaging systems with circular, annular, and Gaussian pupils, and imaging through atmospheric turbulence. Prerequisite: OPTI 503.

Textbooks:

- Mahajan, Virendra N. (2004). Optical Imaging and Aberrations: Part I. Ray Geometrical Optics. SPIE Press.
- Mahajan, Virendra N. (2004). Optical Imaging and Aberrations: Part II. Wave Diffraction Optics. SPIE Press.

Grading Policy:

- 40% Homework
- 30% Midterm
- 30% Final

Outline:

1. Fundamentals of Image Formation
 - Diffraction theory of image formation with emphasis on aberrations
 - Compare diffraction and geometrical PSFs and OTFs
 - Strehl, Hopkins, and Struve ratios
 - Asymptotic behavior of PSF
2. Imaging by systems with circular pupils
 - Aberration-free PSF and beam focusing
 - Strehl ratio and aberration balancing and tolerance
 - Zernike circle polynomial expansion of aberration function
 - Aberrated PSF and its symmetry properties
 - Encircled and ensquared power
 - Aberrated OTF and Hopkins ratio
 - Line of sight and centroid of PSF of an aberrated system
 - Line-spread function and Struve ratio
 - Polychromatic PSFs and OTFs
3. Imaging by systems with annular pupils
 - Discuss similar topics as for systems with circular pupils, including Zernike annular polynomials
4. Imaging by systems with Gaussian pupils
 - Effect of Gaussian apodization on PSF and OTF
 - Zernike-Gauss polynomials and aberration balancing
 - Propagation of Gaussian beams

5. Random Aberrations

- Random image motion
- Fabrication errors
- Propagation through atmospheric turbulence