Detailed Syllabus of the course:

Course: Optical Imaging systems

Course number: 391525

Course objectives: characterization of imaging systems in the visible and infrared regions. Acquiring tools to evaluate optical imaging systems.

Points: 2.5, 3 hrs/week (2 hrs lecture, 1 hr exercise)

Prerequisite courses: radiometry and detection of electromagnetic waves

week	subject	Sub-subject and notes
1	Overview and diffraction	a. Broad overview on the contents of the course b. Scalar diffraction c. Fraunhofer diffraction through lens d. Fourier transform in polar coordinates
2	Diffraction-limited imaging 1	a. Point spread function (PSF) of a system b. Optical Transfer Function (OTF) of optical imaging system c. Modulation Transfer Function (MTF) and Phase Transfer Function (PTF)
3	Diffraction-limited imaging 2	a. The auto-correlation function of the aperture as a second way to calculate OTF b. OTF of Slit aperture c. OTF of Circular aperture
4	Modulation Contrast Function	a. Modulation contrast, definition b. Modulation contrast function (MCF) c. Applying MCF for sine wave and square wave d. The relationship of MCF on the MTF on optical imaging system
5	Contrast-Limited Resolution and target acquisition	a. Spatial-Frequency bandwidth b. Limiting resolution required threshold contrast c. Target acquisition probabilities
6	Contrast-Limited Resolution and target acquisition	a. Navy model for image acquisition b. Textual resolution c. Examples of contrast-Limited resolution
7	Noise-Limited imaging and target acquisition	a. Signal-to-noise current ratio b. Thermal imaging systems
8	Imaging devices	a. Semiconductor image sensors b. CCD structure and principles c. Noise d. Dynamic range and MTF of CCD

9	Influence of motion on imaging	a. General calculation method of OTF of motion b. Linear motion OTF c. Sinusoidal motion OTF d. Quadratic motion OTF
10	Imaging through the Atmosphere 1	a. Effects of the atmosphere on imaging b. Absorption c. Scattering
11	Imaging through the Atmosphere 2	a. Turbulence b. Path-integrated measurements of the refractive index structure function C_n^2 **c.** Long and short exposures MTFs
12	Imaging through the Atmosphere 3	a. Effect of the focal length on the turbulence effects b. Wavelength dependence c. Vertical and slant path viewing d. Imaging horizontally e. Imaging through the atmosphere: comparison of turbulence to Aerosol MTFs
13	Imaging processing and effects on resolution	a. Inverse filters b. Least squares or Wiener filters
14	Image reconstruction	a. Constrained least squares filters b. Atmospheric Wiener filter for correction of atmospheric degradation