Optical Sciences 536
Introduction to Image Science

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Catalog Description:
This course covers the basic theoretical principles of image science and its application in the description of imaging systems, including microscopy systems, medical imaging systems, remote sensing, and astronomy systems. The course provides an understanding how to mathematically descibe an object, the mapping from objects to image data, and the description of how a formed image relates to the underlying object. This course is intended for graduate students in optical sciences or engineering with an appropriate mathematical background at the level of advanced calculus.

Course Outline:

1. Overview of modern imaging and image formation
2. Objects as vectors in a vector space, image formation as a continuous to continuous or continuous to discrete mapping from an object vector space to an image vector space.
3. Eigenfunctions, linear systems, Fourier transforms
4. Indirect imaging, inverse problems, iterative algorithms
5. Geometrical optics description of imaging, radiometry
6. Physical optics description of imaging
7. Coherent and incoherent imaging, diffraction limit
8. Optical and electron microscopy
9. Digital imaging, sampling, image detectors, displays
10. Advanced optical microscopy, optical coherence tomography, near-field imaging
11. Imaging in astronomy and remote sensing
12. Radar, Lidar
13. Sonar, ultrasound imaging
14. Shadow casting, coded apertures
15. X-ray imaging, computed tomography
16. Nuclear imaigng, SPECT, PET
17. Magnetic resonance imaging
18. Classification and estimation tasks
19. Image quality, performance evaluation
20. Image processing