

EE438PMP Optical Sensors and Systems (Autumn 2021)



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Lectures:	-	Room	Fluke Hall 119A

Synopsis

Optical sensors and systems are "eyes" of machines and devices: robots, autonomous vehicles, smart phones, industry automation, security systems, aviation, and so on. These sensors can not only "see" by imaging, but they can also "smell" by detecting chemicals and biomolecules, "feel" by measurement distance and speed, and "hear" by detecting sound waves and vibration. Their functions are based on the same foundation of physical principles of light propagation and light-matter interactions. They also need to be integrated with electronics and computers for signal processing to extract the useful information and suppress noises.

This course will provide a comprehensive introduction to the physical principles of optical sensors and dive deeply into a few examples of sensors and systems. The topics that will be covered are listed below:

Lecture Topics

Fundamental components of optical sensors

- *Light sources: incoherent (thermal, LED) and coherent (lasers) sources*
 - *Photodetectors: photodiodes, photomultipliers, image sensors*
 - *Optical elements: lenses, polarizers, filters, fibers optics, waveguides, optical cavities*
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Optical sensors and applications

- *Eyes: the example of nature*
 - *Distance sensors, motion sensors*
 - *Imaging systems: cameras, microscopes, telescopes*
 - *Spectrometers*
 - *Interferometers*
 - *Ellipsometers*
 - *Light detection and ranging (LIDAR)*
 - *Optical biosensors*
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Optoelectronic integration and systems

- *Understand noises in optical sensors*
 - *Readout electronics for optical sensors*
 - *Signal processing of optical detection*
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Textbook
TBD

Example: Haus, J. (2010). Optical Sensors: Basics and Applications 1st Edition
Wiley-VCH; 1st edition, 1st Edition.

Grading (Tentative)

Homework: 50%

Term Paper: 25%

Exams: 25%

Prerequisite:

Phys 123: Waves, or equivalent, or undergraduate courses on optics at the level of E. Hecht, Optics (Pearson, 5th Ed. 2015).