Biophysics 210: Biological Light Microscopy
Syllabus

Discussion section meets Tuesdays from 1-2:30pm in GH N114
Labs meet Thursday or Friday from 1-4pm GH S252 (CALM)

Week 3: Fourier Optics and Cameras

Goals: Understand what kinds of cameras are commonly used in light microscopy. Know the difference between CCD, EMCCD, and sCMOS cameras. Understand the pros and cons of these cameras, and under what conditions you might choose one camera over another. Know how to choose a magnification to match a camera to your objective resolution (Nyquist sampling). Know how to read and interpret a camera data sheet.

Discussion Section: April 14th GH N114
Labs: April 16th and 17th GH S252 (NIC**)**

Lectures (watch before discussion section):

- Fourier Space
- Abbe Diffraction
- Cameras and Detectors I: How Do They Work?
- Cameras and Detectors II: Specifications and Performance

Note: There is a newer lecture recorded by Nico Stuurman that is part of the Global Bioimaging Light Microscopy course and includes more information on sCMOS cameras.

Additional Reading (optional):

- Lambert and Waters: Assessing camera performance for quantitative microscopy. *Meth. Cell Biol*. **123**, p 35-53, 2014.
- MicroscopyU: Digital Imaging in Optical Microscopy
- James Pawley, More than you ever really wanted to know about charge-coupled devices (appendix 3 of the Handbook of Confocal Microscopy)
- Hamamatsu: Hamamatsu Technical Notes; In particular see "Bridging the Gap", "Do Dim Things", "Revisiting Gen I- and Gen II-sCMOS Cameras for Live-Cell Fluorescence Imaging", "Synchronization and Triggering with the ORCA-Flash4.0 Scientific CMOS Camera"
- Photometrics: "Camera Basics"; "Camera Test Protocol"; and "Advanced Imaging"
- Andor: Andor Learning Center; "EMCCD-Separating the Facts from the Fiction"; "Andor Interactive Camera Brochure" and "Comparing EMCCD vs sCMOS".
- Hamamatsu, Photomultiplier Tubes

- James Janesick, Scientific Charge Coupled Devices
- James Janesick, Photon Transfer: DN → λ

Discussion Section Topic: How to choose a camera and match it to your microscope. We'll work through various examples of different kinds of cameras and what kinds of experiments they would be most useful for.

Lab: Camera calibration (Nikon Imaging Center)