Biophysics 210: Biological Light Microscopy
Syllabus

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

Week 6: Optical Sectioning: Deconvolution and Light Sheet

Goals: Understand the principles of deconvolution and light sheet microscopy. Compare and contrast these approaches to optical sectioning to confocal and two-photon microscopy. Learn several different methods for constructing light sheet microscopes and understand the strengths and weaknesses of each.

Discussion Section: May 5th Lecture about light sheet by Tanner Fadero, and deconvolution by Andy York.

Labs: May 7th and 8th

Lectures (watch before discussion section):

Structured Illumination

Optional lectures (will partially be covered live):

- Deconvolution Microscopy
- Light Sheet Sectioning

Reading required for discussion section:

- Power, RM and Huisken, J (2017) A guide to light-sheet fluorescence microscopy for multiscale imaging. Nature Methods 14:360-373
- Girkin, JM and Carvalho, MT (2018) The light-sheet microscopy revolution. Journal of Optics 20:053002 https://doi.org/10.1088/2040-8986/aab58a

Additional Reading (optional):

- Biomedical Imaging Group: 3D Deconvolution Microscopy
  *This site gives a list of references and open source software solutions.
- Molecular Expressions: Deconvolution Microscopy
- Hillman, EMC et al. (2019) Light-Sheet Microscopy in Neuroscience. Annu Rev Neurosci. 8;42:295-313.

- Wan, Y and McDole K. et al. (2019) Light-Sheet Microscopy and Its Potential for Understanding Developmental Processes. Annu Rev Cell Dev Biol. 6;35:655-681.
- Huygens Deconvolution (Site for commercial software)
- Pawley, JB (2006) Handbook of Biological Confocal Microscopy, 3rd edition. Plenum, New York: See chapters 23 (Comparison of Widefield/Deconvolution and Confocal Microscopy for Three-Dimensional Imaging), 24 (Blind Deconvolution) and 25 (Image Enhancement by Deconvolution).
- Goodwin, PC (2014) Quantitative deconvolution microscopy. Methods in Cell Biology 123:177-192
- Wallace, W et al. (2001) Workingperson's Guide to Deconvolution in Light Microscopy. BioTechniques 31:1036-1097
- BINA webinar: Lattice Lightsheet, Build or Buy?
- Hari Shroff (2021) Light Sheet Fluorescence Microscopy fundamentals (webinar)
- Millett-Sikking et al. (2019) High NA single-objective light-sheet (AKA Snouty scope, definitely worth checking out the figures)
- Gibbs HC et al. (2021) Navigating the Light-Sheet Image Analysis Software Landscape: Concepts for Driving Cohesion From Data Acquisition to Analysis. Front Cell Dev Biol. 2021 Nov 1;9:739079.
- Yang B et al. (2022) DaXi—high-resolution, large imaging volume and multi-view single-objective light-sheet microscopy. Nat Methods. 19(4):461-469.
- OpenSPIM project
- McDole K et al. (2018) In Toto Imaging and Reconstruction of Post-Implantation Mouse Development at the Single-Cell Level. Cell. 175(3):859-876.e33.
- Elisa, Z et al. (2018) Technical implementations of light sheet microscopy. Microsc Res Tech 2018;1-18 DOI: 10.1002/jemt.22981
- Wu, Y et al (2013). Spatially isotropic four-dimensional imaging with dual-view plane illumination microscopy. Nature Biotechnology 31(11):1032-1038
- Planchon, TA et al (2011) Rapid three-dimensional isotropic imaging of living cells using Bessel beam plane illumination. Nature Methods 8:417-423
- Chen, BC et al (2014) Lattice light-sheet microscopy: imaging molecules to embryos at high spatiotemporal resolution. Science 346 (6208):1257998. doi: 10.1126/science.1257998.

Discussion Section Topic: We will discuss different light sheet microscopy configurations and the strengths and weakness for each. We will also discuss important considerations for performing deconvolution microscopy.

Lab: We will have examples of light sheet, SIM, iSIM and Deconvolution