Cold Spring Harbor Laboratory Course on:
Quantitative Imaging: From Acquisition to Analysis
March 29- April 12, 2022

INSTRUCTORS:
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CO-INSTRUCTOR:
Suliana Manley, Ecole Polytechnique Federale de Lausanne, SWITZERLAND

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Combining careful image acquisition with rigorous computational analysis allows extraction of quantitative data from light microscopy images that is far more informative and reproducible than what can be seen by eye. This course focuses on advanced quantitative fluorescence microscopy techniques used for imaging a range of biological specimens, from tissues to cells to single molecules. The course is designed for quantitative cell and molecular biologists, biophysicists and bioengineers.

We provide a thorough treatment of the complete process of quantitative imaging, from the photons emitted from the sample to the extraction of biologically meaningful measurements from digital images. Material is covered in lectures, discussion groups and hands-on quantitative exercises using commercial microscopes and open-source image analysis tools.

Concepts Covered Included:
- Widefield fluorescence microscopy
- Laser scanning and spinning disk confocal microscopy
- CCD, EM-CCD & sCMOS cameras
- Total internal fluorescence microscopy (TIRF)
- Light sheet microscopy
- Super-resolution microscopy (structured illumination, STED & localization microscopy)
- Imaging and analyzing ratiometric “biosensors” (including FRET)
- Fluorescent proteins and live sample imaging
- Image processing (filtering, de-noising, corrections, and deconvolution)
- Image segmentation
- Quantitative shape and intensity measurements
- Object detection and tracking
- Machine learning
- Designing and troubleshooting quantitative imaging experiments

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PARTICIPANTS:

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Seminars:

Jennifer Waters, Harvard Medical School, Boston, MA
"Introduction to Quantitative Microscopy"
"Objective Lenses"
"Koehler Illumination & Image Formation"
"Phase, Darkfield & DIC Microscopy"
"Quantifying Fluorescence: Image acquisition & controls"
"Live Cell Imaging"
"Total Internal Reflection Fluorescence (TIRF) Microscopy"
"Live Confocal Microscopy & Intensity Measurements over Time"
"Multi-photon microscopy"
"Limitations on Quantitative Imaging of Thick Samples"
"Light Sheet Microscopy, Party 1"

Hunter Elliott, Harvard Medical School, Boston, MA
"Digital Imaging: Cameras"

"Basics of Image Processing & Digital Microscopy: Resolution, SNR & diffraction limited objects"
"Image Processing 2: Image corrections and advanced filtering"
"Image segmentation and morphometry"
"Image correlation methods: co-localization, registration & stitching"
"Machine Learning in Bioimage analysis"
"3D Image Analysis & Deconvolution"
"Image time series analysis: Tracking, Photo-Bleach correction & FRAP analysis"

Nathan Shaner, The Scintillon Institute, San Diego, CA
"Fluorescent Proteins"
Florian Jug, Max Planck Institute CBG, Dresden, GERMANY
"Applied Machine Learning"
"Content-Aware Image Restoration"

Jan Witkowski, Cold Spring Harbor Laboratory, NY
"Ethics & Rigor in the Biosciences"

Talley Lambert, Harvard Medical School, Boston, MA
"Confocal Microscopy Theory & Hardware"
"Light Sheet Microscopy, Part 2"
"Super-Resolution Microscopy II Patterned illumination"

Suliana Manley, Ecole Polytechnique Federale de Lausanne (EPFL), SWITZERLAND
"Super-Resolution Microscopy I, Localization"
"*Expanding Horizons with Large Field-of-View, Automated Localization Microscopy"*

Reto Fiolka, UT Southwestern Medical Center
TBA