Fourier Optics and Quantitative Phase Imaging

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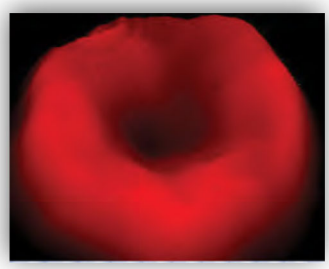
15 hours



Methods (8 hours)

1. Introduction
    a) Microscopy, QPI
    b) Groundwork: plane wave, spherical waves, Fourier Optics, scattering and the Born approximation
    c) Light microscopy: imaging theory, resolution and contrast
2. Precursors to QPI
    a) Holography: Gabor's, off-axis, digital holography
    b) Point-scanning QPI methods: LCI, OCT, QPI
3. Full-field QPI
    a) Principles and figures of merit
    b) Off-axis methods: DHM, HPM
    c) Phase-shifting methods: DRIMAPS, OQM
    d) Common-path: FPM, DPM
    e) White-light: TIE, SLIM
4. Fourier transform light scattering (FTLS)
    a) Static scattering: scattering-phase theorem
    b) Dynamic scattering: dispersion-relation phase spectroscopy (DPS)

Applications (5 hours)

1. Imaging
    a) Cell imaging
    b) Tissue imaging
    c) Tomography
2. Scattering
    a) non-biological: beads
    b) bacteria
    c) FTLS static and dynamic
3. Spectroscopic QPI
    a) Multi-wavelength
    b) Hyperspectral QPI
    c) Hemoglobin concentration measurement
4. Multimodal: QPI + X
    a) QPI + confocal

b) QPI + fluorescence
c) QPI + Raman
d) QPI + plasmonic NPs
e) QPI + AI

QPI at Illinois (2 hours)

a) Current methods
b) Current applications

References

1. Popescu, G. (2011). Quantitative phase imaging of cells and tissues. New York, McGraw-Hill.
2. Park, Y., C. Depeursinge and G. Popescu (2018). "Quantitative phase imaging in biomedicine." Nature Photonics 12(10): 578.