

Computational structured illumination microscopy with scattering media for high-throughput fluorescent and phase imaging

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Abstract:

We describe a dual fluorescent- and phase- imaging technique using structured illumination (SI) patterns [1,2] generated by scattering media (Scotch Tape) to achieve resolution 4x beyond the microscope's diffraction limit. Three sensors collect images as the Scotch Tape is translated laterally. In the fluorescent arm, an iterative joint estimation algorithm based on [3,4] is developed to reconstruct both the sample and the illumination pattern. In the coherent (laser) arm, we solve for phase information from images at two focus distances. Using a low numerical aperture (NA) objective lens (with a large field-of-view), we are targeting multi-modal high-throughput imaging with both super-resolution fluorescent and phase imaging incorporated simultaneously.

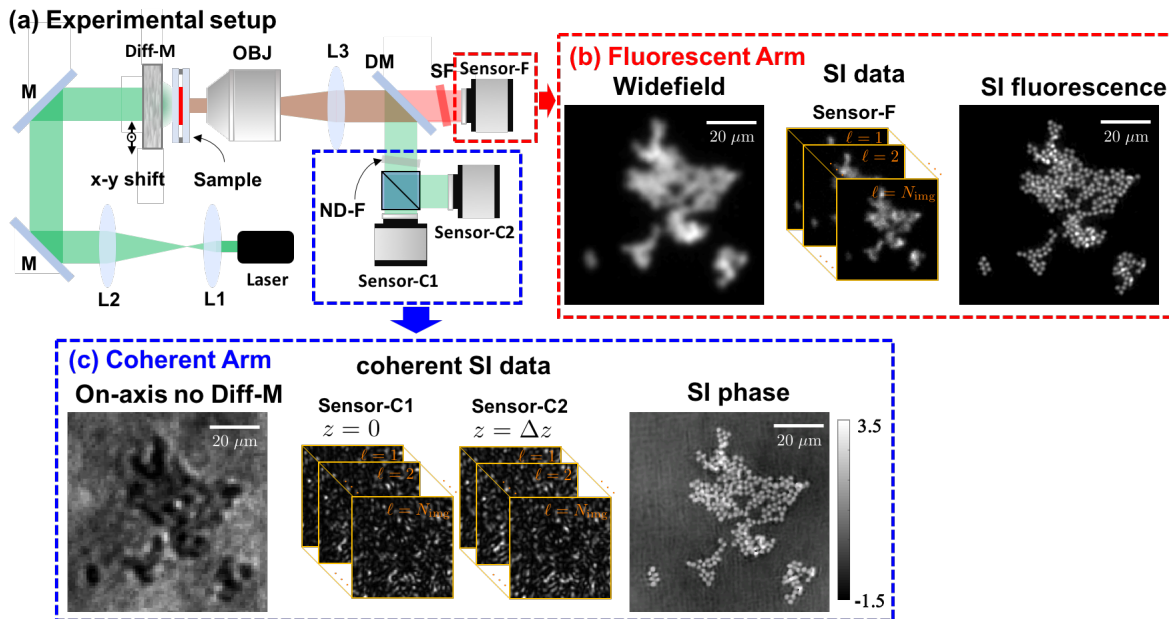


Figure 1: (a) Experimental setup imaging $2.19\mu\text{m}$ red fluorescent beads with $\text{NA} = 0.1$. Three sensors simultaneously record data as the Scotch Tape is scanned laterally. (b) From the fluorescent arm: diffraction-limited fluorescent image (i.e., widefield), raw SI data images, and the super-resolved reconstruction. (c) From the coherent (laser) arm: in-focus diffraction-limited coherent intensity image, raw datasets from Sensor-C1 and Sensor-C2, which are separated by defocus, and the super-resolved phase reconstruction.

References

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