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*Xiaowei Zhuang (Harvard/HHMI) Part 1: Super-Resolution Fluorescence Microscopy*  
*Microscopy: Super-Resolution Microscopy (Xiaowei Zhuang)*  
**An introduction to super-resolution microscopy of living cells**  
**Super resolution microscopy | Stimulated emission depletion (STED) microscopy**  
Introduction to Super-Resolution Localization Microscopy  
Microscopy: Super-Resolution: Structured Illumination Microscopy (SIM) (David Agard)  
*Microscopy: Super-Resolution: Overview and Stimulated Emission Depletion (STED) (Stefan Hell)*  
*DeltaVision OMX Flex super-resolution microscope: Product overview*

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A. Diaspro - Cutting-edge technology: super-resolution fluorescence microscopy  
**Microscopy: Super-Resolution: Localization Microscopy (Bo Huang)**  
Microscopy: Designing a Fluorescence Microscopy Experiment (Kurt Thorn)  
*BioTechniques - Super Resolution Microscopy 3D Microscopes: To boldly go... Class I Speaker - Xiaowei*

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Zhuang ? *The benefits of magnification beyond resolution | Amateur Microscopy Inside The World's Most Powerful New Microscopes 20\_* *STORM Microscopy\_Paulsen Microscopy: Phase, Polarization, and DIC (Stephen Ross) Lattice light-sheet microscopy Microscopy: Resolution (Jeff Lichtman) Microscopy: Diffraction (Jeff Lichtman) Principles of STED microscopy Viewing super-resolution cells in real time Super resolution fluorescence microscopy's nanometer resolution gain insights into bacterial cells Super-resolution microscopy Seminar: Localization-Based Super-Resolution Fluorescence Imaging Jennifer Lippincott-Schwartz (NIH) Part 3: Super Resolution Imaging Single-molecule fluorescence microscopy enables super-resolution imaging of DNA replication and... Eric Betzig: development of super-resolved fluorescence microscopy Ghost Imaging Speeds Up Super-Resolution Microscopy Super Resolution Fluorescence Microscopy Department*

Recently, several new technologies, collectively termed super-resolution microscopy or nanoscopy, have been developed that break or bypass the classical diffraction limit and shift the optical resolution down to macromolecular or even molecular levels . Some of these technologies have now matured from the breadboard stage to commercially available imaging systems, making them increasingly attractive for broad applications and defining a new state of the art.

*A guide to super-resolution fluorescence microscopy ...*

Achieving a spatial resolution that is not limited by the diffraction of light, recent developments of super-resolution fluorescence microscopy techniques allow the observation of many biological structures not resolvable in conventional fluorescence microscopy. New advances in these techniques now give them the ability to image three-dimensional (3D) structures, measure interactions by ...

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*Super-Resolution Fluorescence Microscopy | Annual Review*

...

Pushing the Limits of Fluorescence Microscopy: Fluorescent Probes for Super Resolution Imaging Technologies ( BioProbes® 64) Beyond light's limits: Fluorescence imaging at the nanoscale—Fluorescent probes for three super-resolution modalities—STORM, SIM, and STED microscopy ( BioProbes® 70) Fluorescence SpectraViewer.

*Super-Resolution Microscopy | Thermo Fisher Scientific - UK*

This is where fluorescence microscopy steps in, hence the rapid development of super-resolution fluorescence microscopy as a field of physical sciences and the two Nobel Prizes already awarded for...

*Microscopy beyond the resolution limit | EurekAlert ...*

Super-resolution fluorescence microscopy is an important tool in biomedical research for its ability to discern features smaller than the diffraction limit. However, due to its difficult implementation and high cost, the super-resolution microscopy is not feasible in many applications.

*Super-resolution fluorescence microscopy by stepwise ...*

Super Resolution Fluorescence Microscopy Department Achieving a spatial resolution that is not limited by the diffraction of light, recent developments of super-resolution fluorescence microscopy techniques allow the observation of many biological structures not resolvable in conventional fluorescence microscopy.

*Super Resolution Fluorescence Microscopy Department Of*  
Huang B, Bates M, Zhuang X. Super-resolution fluorescence microscopy. *Annu Rev Biochem.* 2009;78:993-1016. Bates M,

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Huang B, Zhuang X. Super-resolution microscopy by nanoscale localization of photo-switchable fluorescent probes. *Curr Opin Chem Biol.* 2008 Oct;12(5):505- 14.

## *Super-Resolution Fluorescence Microscopy*

Spectral precision distance microscopy (SPDM) is a family of localizing techniques in fluorescence microscopy which gets around the problem of there being many sources by measuring just a few sources at a time, so that each source is "optically isolated" from the others (i.e., separated by more than the microscope's resolution, typically ~200-250 nm), if the particles under examination have different spectral signatures, so that it is possible to look at light from just a few molecules at a ...

## *Super-resolution microscopy - Wikipedia*

Super-resolution microscopy, whilst it can allow the observer to peer more deeply into nature, cannot be used at the molecular level. For this type of research, there is an even more powerful tool...

## *Super-Resolution Microscopy vs. Electron Microscopy*

Super-resolution imaging is now achievable on a conventional epi-fluorescence microscope with little to no modification to the optical design. The fine structural information embedded in a sequence of fluorescence images can be restored using single particle localization as implemented in STORM and PALM, or intensity fluctuation statistics as in SOFI, ICA and SCORE.

## *Spatial Covariance Reconstructive (SCORE) Super-Resolution ...*

Next, we incorporate optimization into the study of a super-resolution fluorescence microscopy technique, structured

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illumination microscopy. Super-resolution reconstruction is achieved even with a series of random unknown illumination patterns, which is not possible without proper optimization formulation.

## *Computational fluorescence and phase super-resolution ...*

Imaging methods for cells and tissues have progressed rapidly in the past decade, providing unrivalled opportunities for new insights into biological molecular mechanisms [1–3]. While many of the highest profile developments have been in super-resolution fluorescence and single molecule methods, other innovations in electron or X-ray microscopy have facilitated visualisation of ultrastructural morphology [4,5].

## *CryoSIM: super resolution 3D structured illumination ...*

The team experimented with the concept of digital holography for fast fluorescence detection by tracking the three-dimensional (3-D) trajectory of individual nanoparticles using an in-plane ...

## *Holographic fluorescence imaging to 3-D track ...*

Here we describe a new method, named LS-SOFI, that combines light-sheet fluorescence microscopy and super-resolution optical fluctuation imaging to achieve fast nanoscale-resolution imaging over large fields of view in native 3D tissues. We demonstrate the use of LS-SOFI in super-resolution analysis of neuronal structures and synaptic proteins,

## *Super-resolution light-sheet fluorescence microscopy by SOFI*

This is where fluorescence microscopy steps in, hence the rapid development of super-resolution fluorescence microscopy as a field of physical sciences and the two Nobel

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Prizes already awarded for...

## *Moving microscopy beyond the resolution limit*

Super-resolution fluorescence microscopy (nanoscopy) enables imaging with a spatial resolution much higher than the diffraction limit of optical microscopy. However, the methods of fluorescence nanoscopy are still poorly suitable for studying living cells. In this review, we describe some examples of live nanoscopy-based discoveries and focus on the development of methods for nanoscopy and specific fluorescent labeling aimed to decrease the damaging effects of light illumination on live samples.

## *Live-Cell Super-resolution Fluorescence Microscopy ...*

Several methodologies have been developed over the past several years for super-resolution fluorescence microscopy including saturated structured-illumination microscopy (SSIM), stimulated emission depletion microscopy (STED), photoactivated localization microscopy (PALM), fluorescence photoactivation localization microscopy (FPALM), and stochastic optical reconstruction microscopy (STORM).

## *Review of super-resolution fluorescence microscopy for biology*

We improve multiphoton structured illumination microscopy using a nonlinear guide star to determine optical aberrations and a deformable mirror to correct them. We demonstrate our method on bead phantoms, cells in collagen gels, nematode larvae and embryos, *Drosophila* brain, and zebrafish embryos. Peak intensity is increased (up to 40-fold) and resolution recovered (up to  $176 \pm 10$  nm laterally,  $729 \pm 39$  nm axially) at depths  $\approx 250$   $\mu$ m from the coverslip surface.

## *Adaptive optics improves multiphoton super-resolution*

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## *imaging*

Multicolor super-resolution fluorescence microscopy has been demonstrated by several means, such as employing fluorophores with different fluorescence activation wavelengths, 12 – 15 fluorophores with well-separated emission spectra, 9, 16 – 19 by ratio-metric imaging of fluorophores with overlapping emission spectra, 9, 20, 21 or by taking advantage of other spectral properties, such as fluorescence lifetime. 22

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