(SD2023-059) Super Resolution Microscopy with A-POD Deconvolution

Tech ID: 32950 / UC Case 2021-Z08-1

BACKGROUND

Unlike traditionally-mapped Raman imaging, stimulated Raman scattering (SRS) imaging achieved the capability of imaging metabolic dynamics and a greatly improved signal-noise-ratio. However, its spatial resolution is still limited by the numerical aperture or scattering cross-section.

TECHNOLOGY DESCRIPTION

To achieve super-resolved SRS imaging, researchers at UC San Diego developed a new deconvolution algorithm – Adam optimization-based Pointillism Deconvolution (A-PoD) – for SRS imaging, and demonstrated a spatial resolution of 52 nm on polystyrene beads. By changing the genetic algorithm to A-PoD, the image deconvolution process was shortened by more than 3 orders of magnitude, from a few hours to a few seconds. By applying A-PoD to spatially correlated multi-photon fluorescence (MPF) imaging and deuterium oxide (D2O)-probed SRS (DO-SRS) imaging data from diverse samples, they compared nanoscopic distributions of proteins and lipids in cells and subcellular organelles. The researchers successfully differentiated newly synthesized lipids in lipid droplets using A-PoD coupled with DO-SRS. The A-PoD-enhanced DO-SRS imaging method was also applied to reveal the metabolic change in brain samples from Drosophila on different diets. This new approach allows researchers to quantitatively measure the nanoscopic co-localization of biomolecules and metabolic dynamics in organelles. This A-PoD algorithm may have a wide range of applications, from nano-scale measurements of biomolecules to processing astronomical images.

To significantly enhance the data processing speed and precision of SUPPOSe, they developed a deconvolution method, named A-PoD (Adam-based Pointillism Deconvolution), that uses Adaptive Moment Estimation (Adam) solver instead of a genetic algorithm for optimization process. The gradient descent algorithm, Adam, removes the randomness in the genetic algorithm and enables them to enhance the spatial precision and shorten the data processing time. The researchers applied A-PoD to SRS imaging, and generated a series of super-resolved images of mammalian cells and tissues, as well as Drosophila brain tissues. These images displayed nanoscopic distributions of protein and lipid in biological samples. They further measured the shapes and sizes of individual lipid droplets (LDs) in Drosophila brain samples and examined the effects of high glucose diet on brain lipid metabolism and the size distribution of LDs. Our A-PoD algorithm achieves super-resolution images with higher spatial precision than existing deconvolution methods and at a markedly enhanced speed for image processing.

INTELLECTUAL PROPERTY INFO

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OTHER INFORMATION

KEYWORDS
super resolution, deconvolution, super resolution imaging

CATEGORIZED AS
- Imaging
  - Molecular

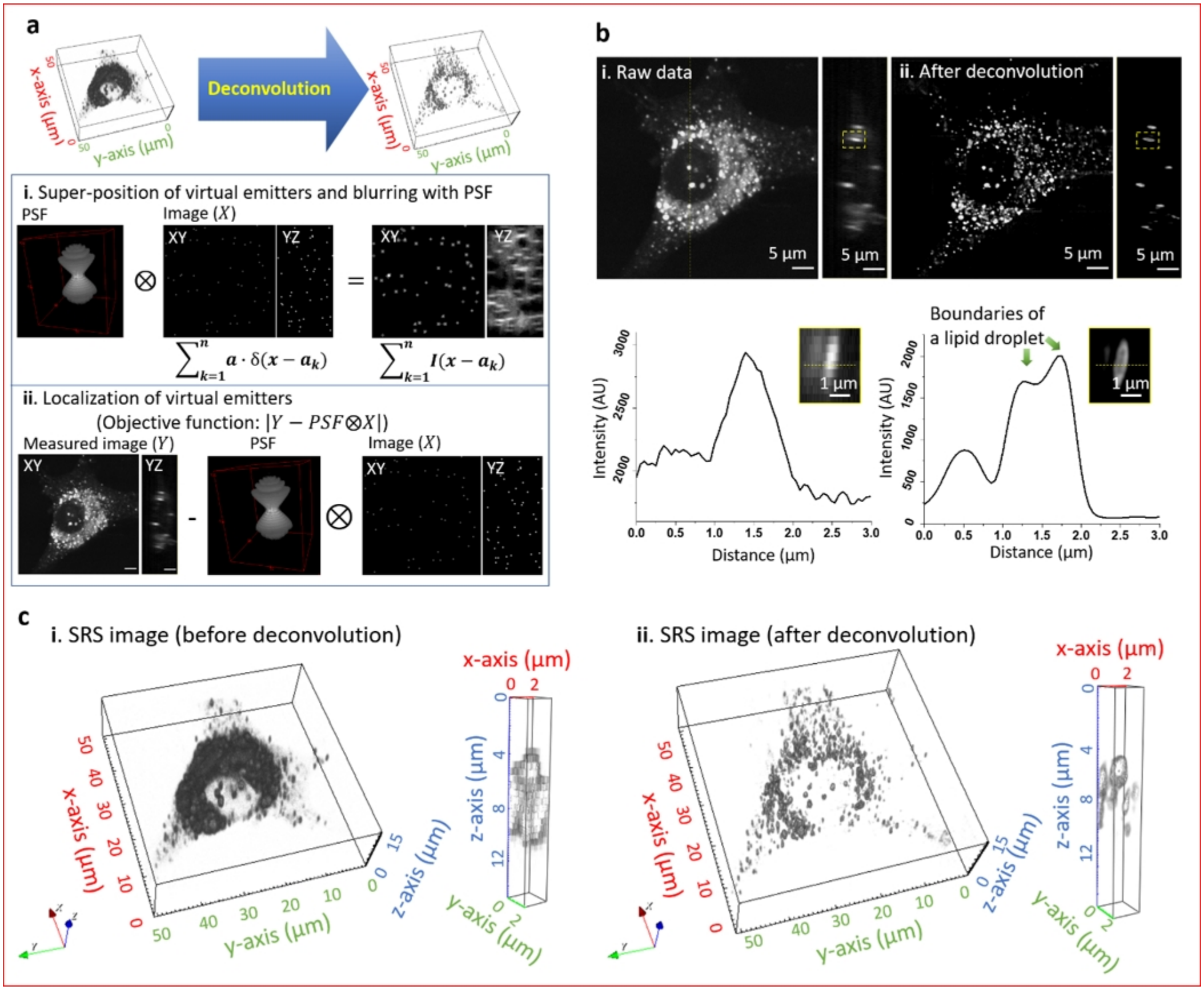
RELATED CASES
2021-Z08-1

Software code and patent rights are available for licensing into commercial products.

RELATED MATERIALS

▶ Super-resolution stimulated Raman Scattering microscopy with A-PoD Hongje Jang, Yajuan Li, Anthony A. Fung, Pegah Bagheri, Khang Hoang, Dorota Skowronska-Krawczyk, Xiaoping Chen, Jane Y. Wu, Bogdan Bintu, Lingyan Shi bioRxiv 2022.06.04.494813; doi: https://doi.org/10.1101/2022.06.04.494813 - 06/05/2022

INNOVATION



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