Breakout Session 1: Track B

Cloud Computing for Optical Image Restoration and Intramural Training

Dr. Johnny Tam (Moderator), *Senior Investigator, NIH/NEI*
Dr. Vineeta Das, P*ostdoc, NIH/NEI*
Dr. Jiamin Liu, *Staff Scientist, Advanced Imaging and Microscopy (AIM) Resource, NIH*

Cloud Computing for Optical Image Restoration and Intramural Training

Johnny Tam, Jiamin Liu, and Vineeta Das

NEI, NIBIB, and AIM

Intramural Research Program, National Institutes of Health

Objectives

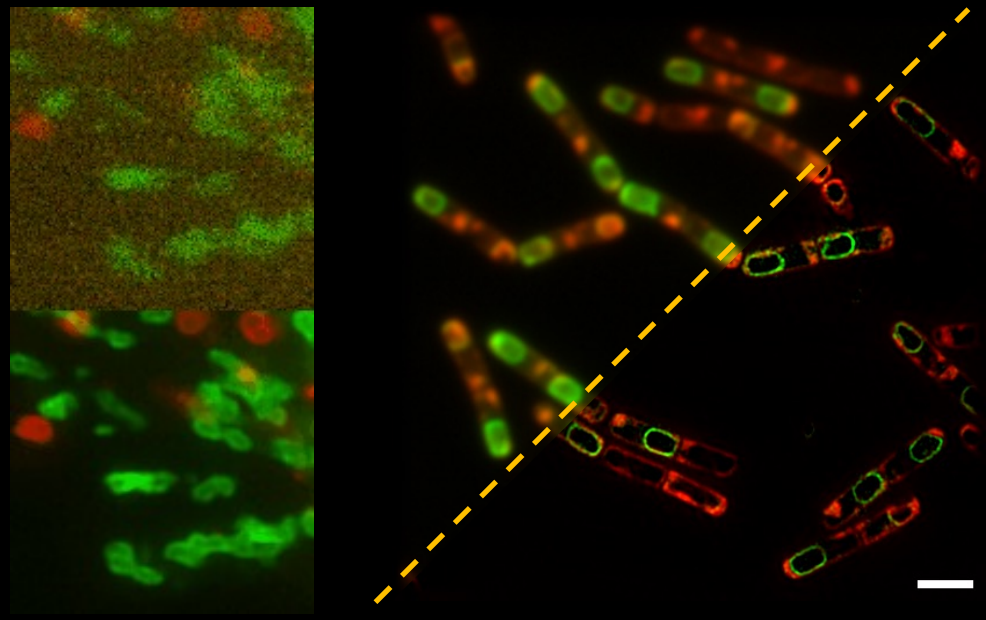
1. Develop and apply artificial intelligence-based methods to imaging datasets in the cloud.

2. Train the next generation of data scientists by creating a small community of cloud users interested in optical imaging and microscopy.

Part 1: Cloud computing for optical microscopy

Jiamin Liu
Advanced Imaging and Microscopy (AIM) Resource

Deep Learning to Denoise and Enhance Resolution for Super Resolution Imaging



Advanced Imaging and Microscopy Resource (AIM)
NIBIB, NIH

ARTICLES
https://doi.org/10.1038/s41592-021-01155-x
nature methods

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Three-dimensional residual channel attention networks denoise and sharpen fluorescence microscopy image volumes

Jiji Chen[1,10] ✉, Hideki Sasaki[2,3,10] ✉, Hoyin Lai[2,3,10], Yijun Su[1,2,3,4,10], Jiamin Liu[1], Yicong Wu[4], Alexander Zhovmer[5], Christian A. Combs[6], Ivan Rey-Suarez[7,8], Hung-Yu Chang[2,3], Chi Chou Huang[2,3], Xuesong Li[4], Min Guo[4], Srineil Nizambad[1], Arpita Upadhyaya[7,8,9], Shih-Jong J. Lee[2,3], Luciano A. G. Lucas[2,3,11] and Hari Shroff[1,4,11]

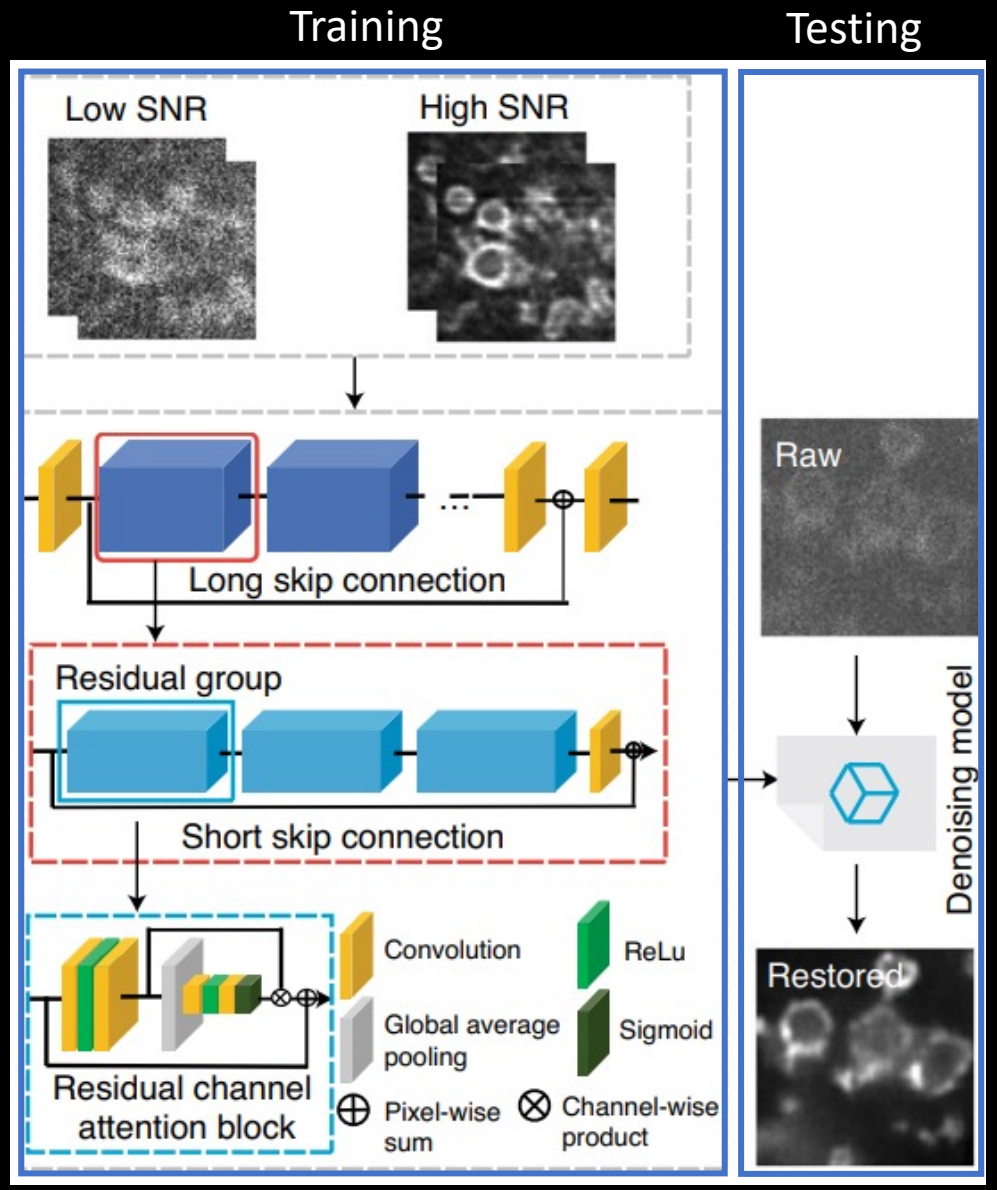
nature biotechnology

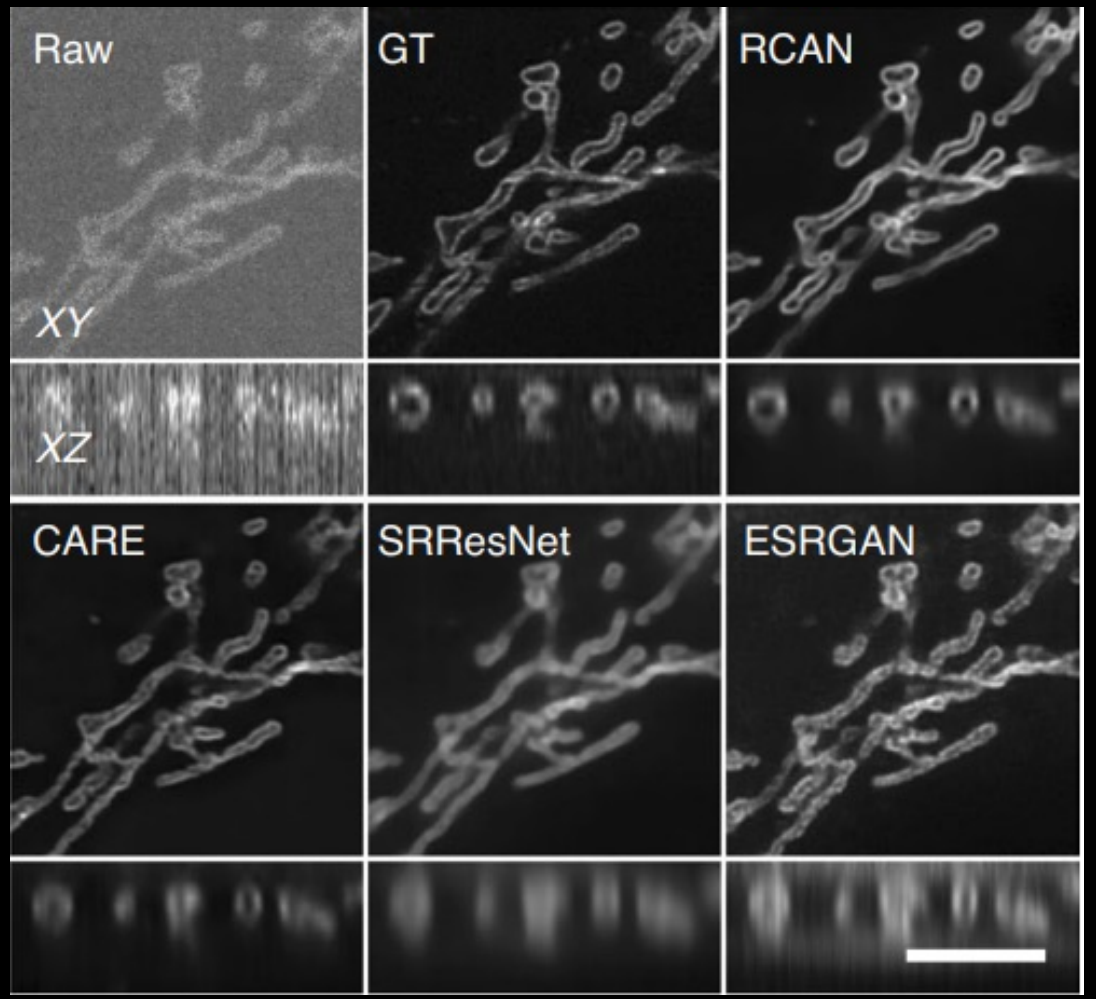
Article
https://doi.org/10.1038/s41587-022-01651-1

Three-dimensional structured illumination microscopy with enhanced axial resolution

Received: 15 August 2022
Accepted: 16 December 2022
Published online: 26 January 2023
Check for updates

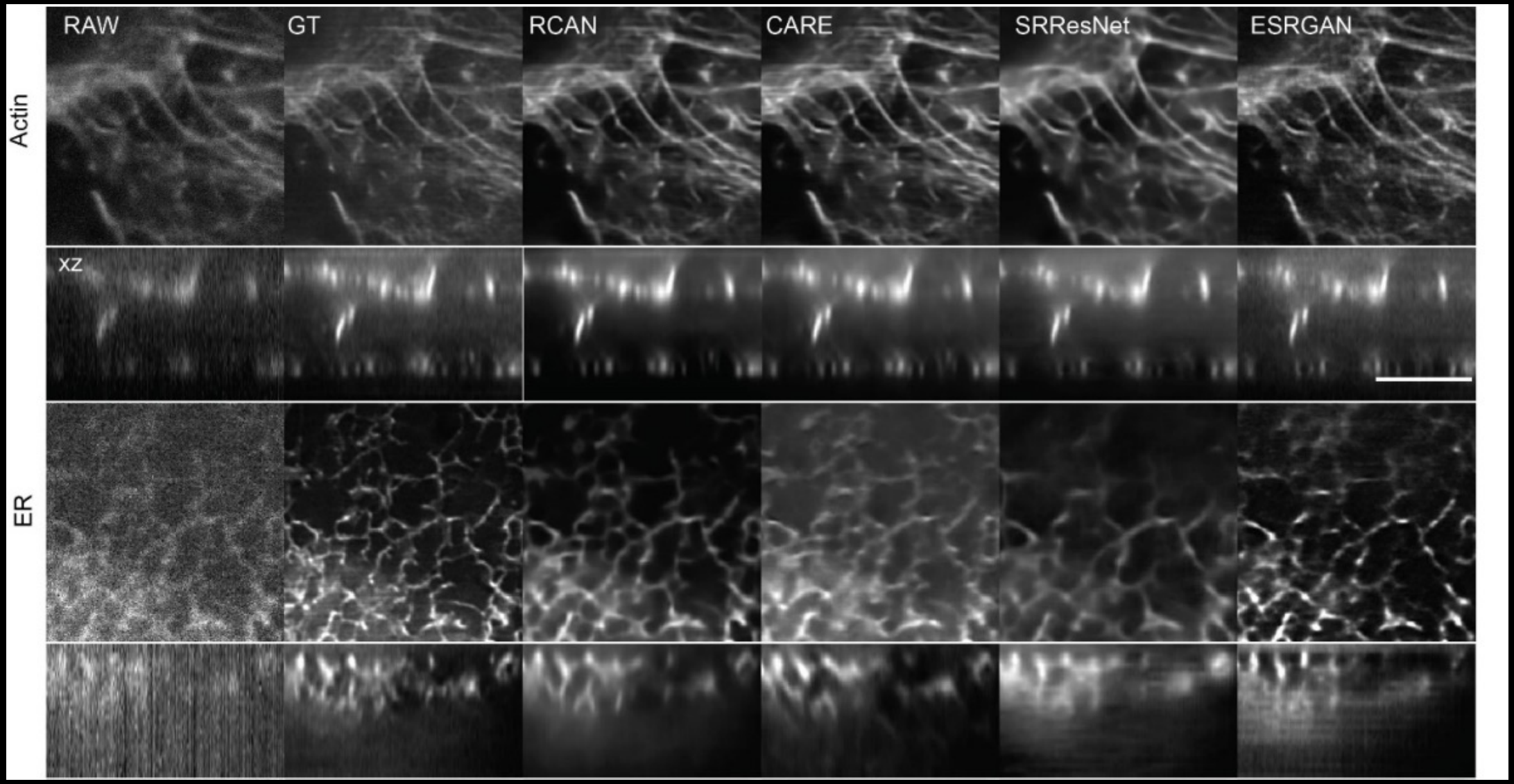
Xuesong Li[1,14] ✉, Yicong Wu[1,2] ✉, Yijun Su[1,2,3,4,14], Ivan Rey-Suarez[5], Claudia Matthaeus[6], Taylor B. Updegrove[7], Zhuang Wei[8], Lixia Zhang[2], Hideki Sasaki[3,4], Yue Li[9], Min Guo[1,15], John P. Giannini[1], Harshad D. Vishwasrao[2], Jiji Chen[2], Shih-Jong J. Lee[3,4], Lin Shao[10], Huafeng Liu[9], Kumaran S. Ramamurthi[7], Justin W. Taraska[6], Arpita Upadhyaya[5,11], Patrick La Riviere[12,13] & Hari Shroff[1,2,13,14]



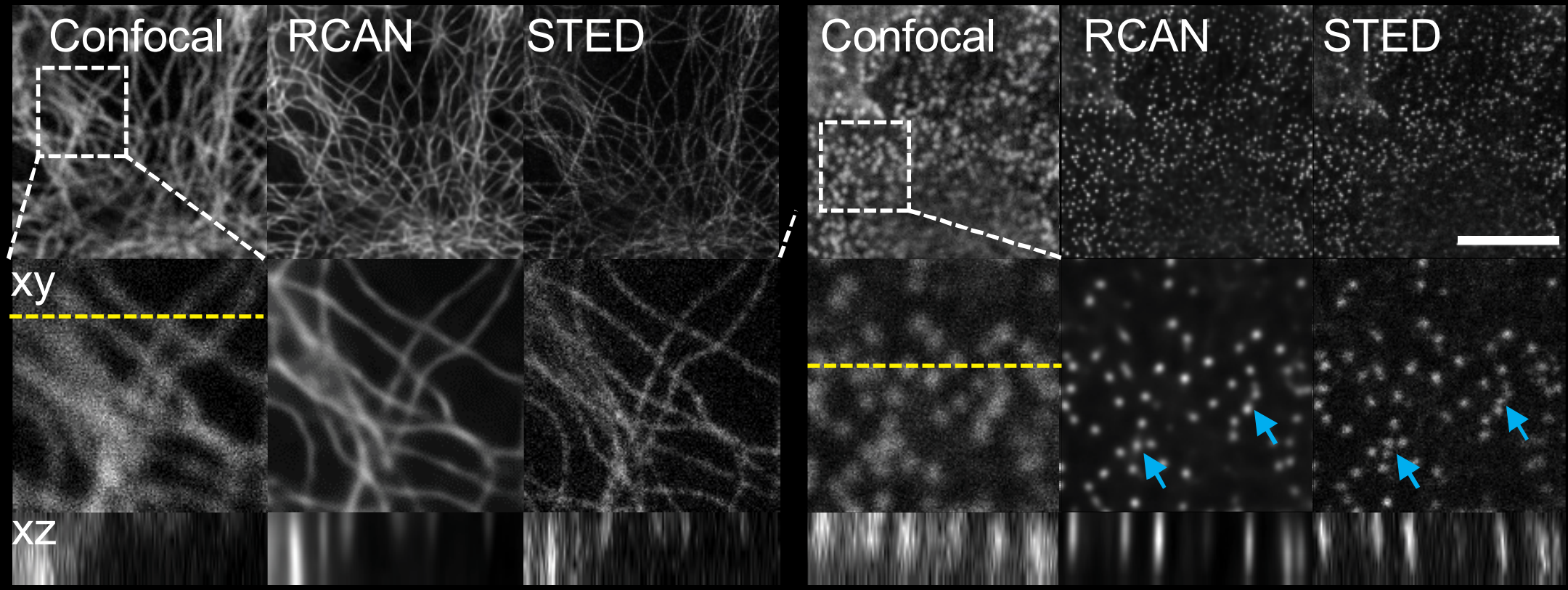


CARE: Content-aware image restoration Nat Methods. 2018 Dec;15(12):1090-1097.
ESRGAN: Enhanced super resolution generative adversarial network arXiv:1809.00219v2
SRResNet: Super resolution ResNet arXiv:1609.04802v5

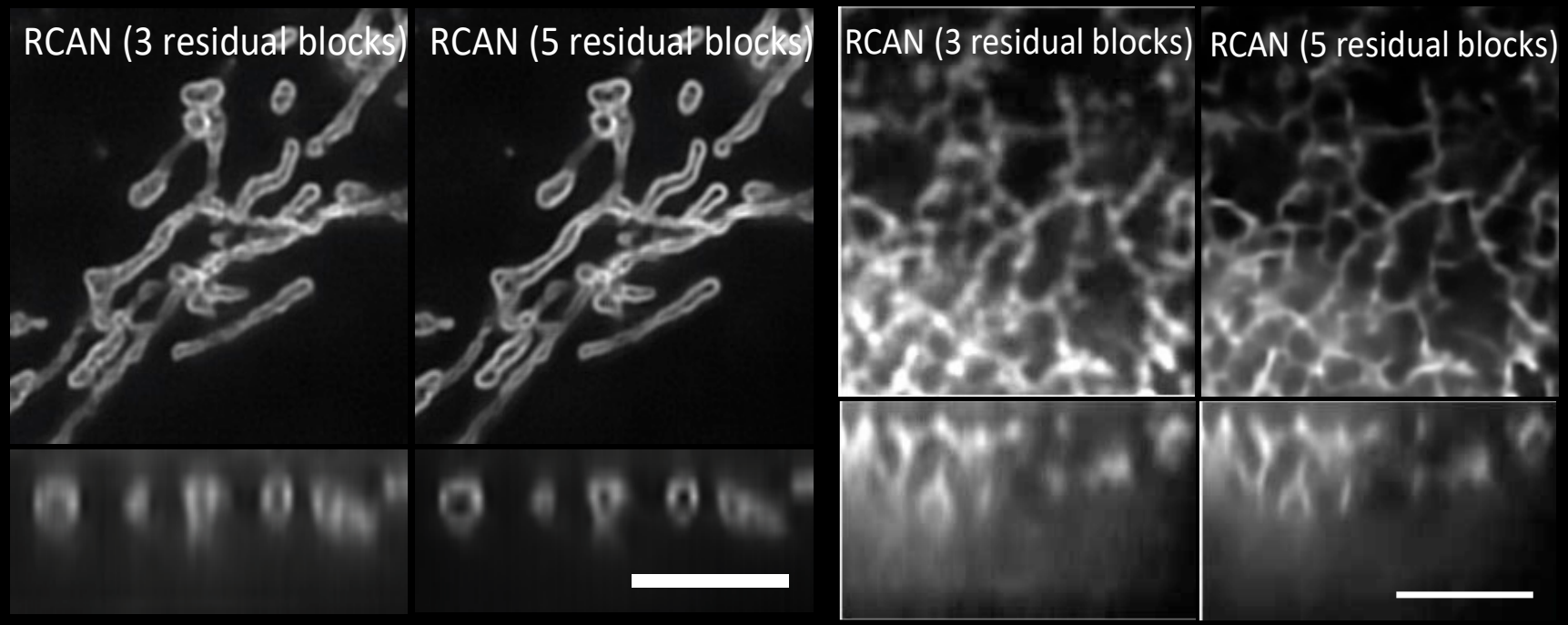
RCAN vs State-of-Art Methods



Cross Imaging Modality: Confocal to STED



Hyperparameters Tuning



More residual blocks increase 3D RCAN performance.
It requires much more training time and high-end GPU.

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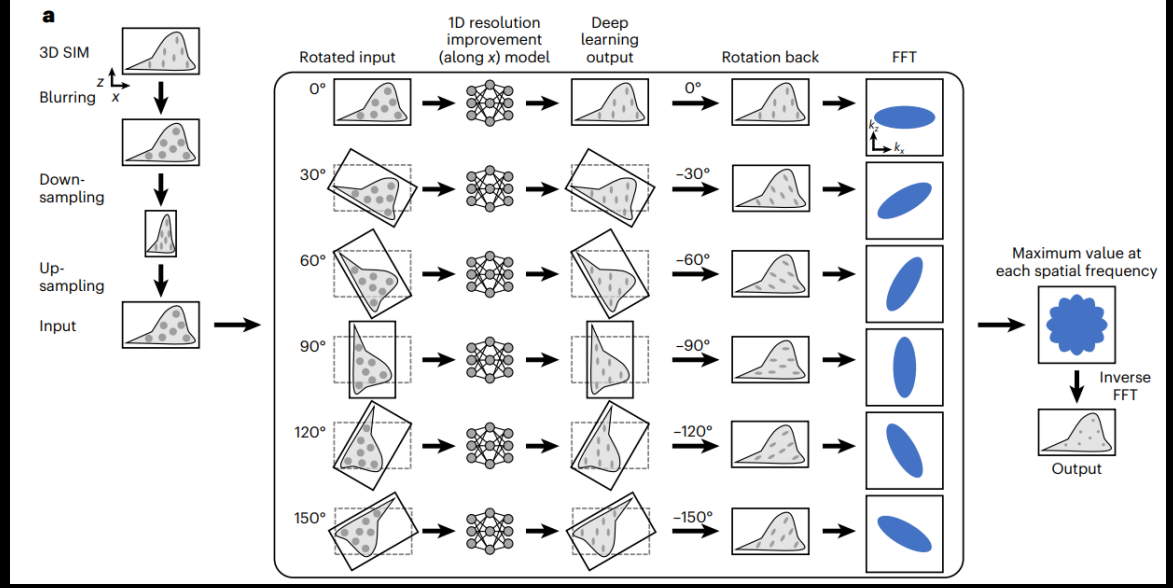
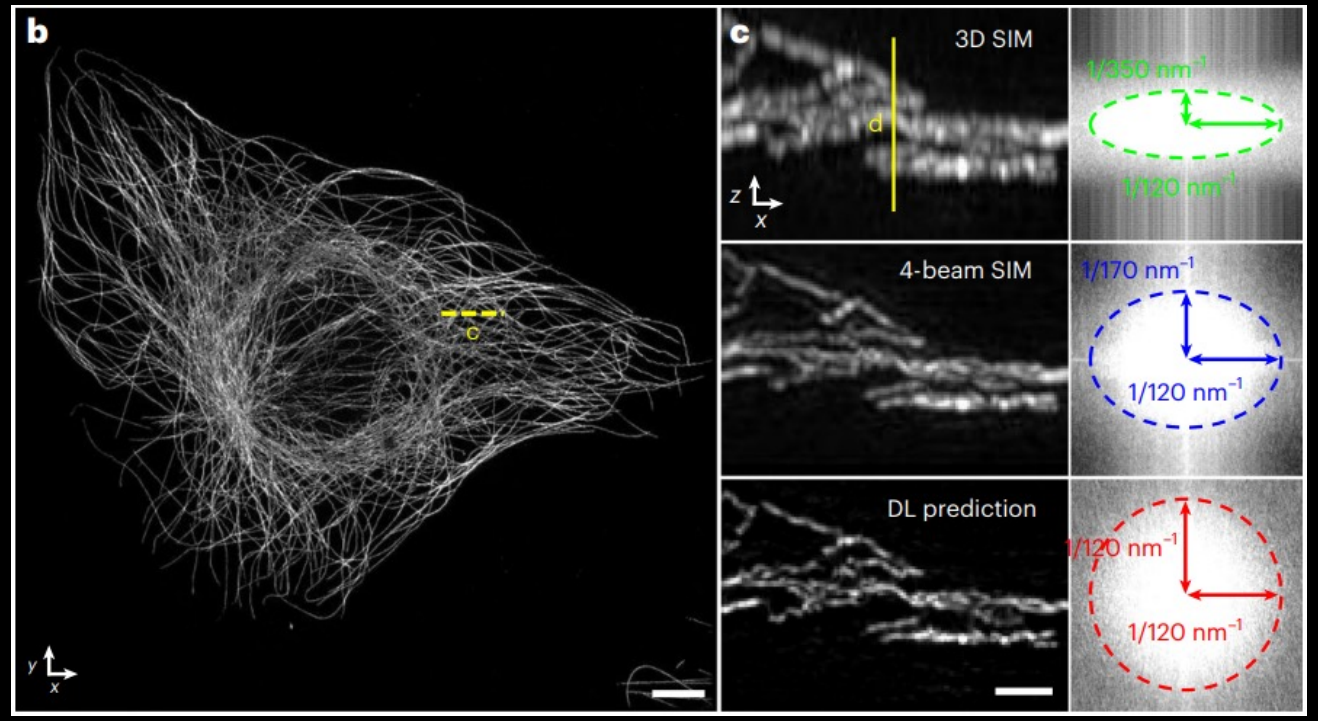
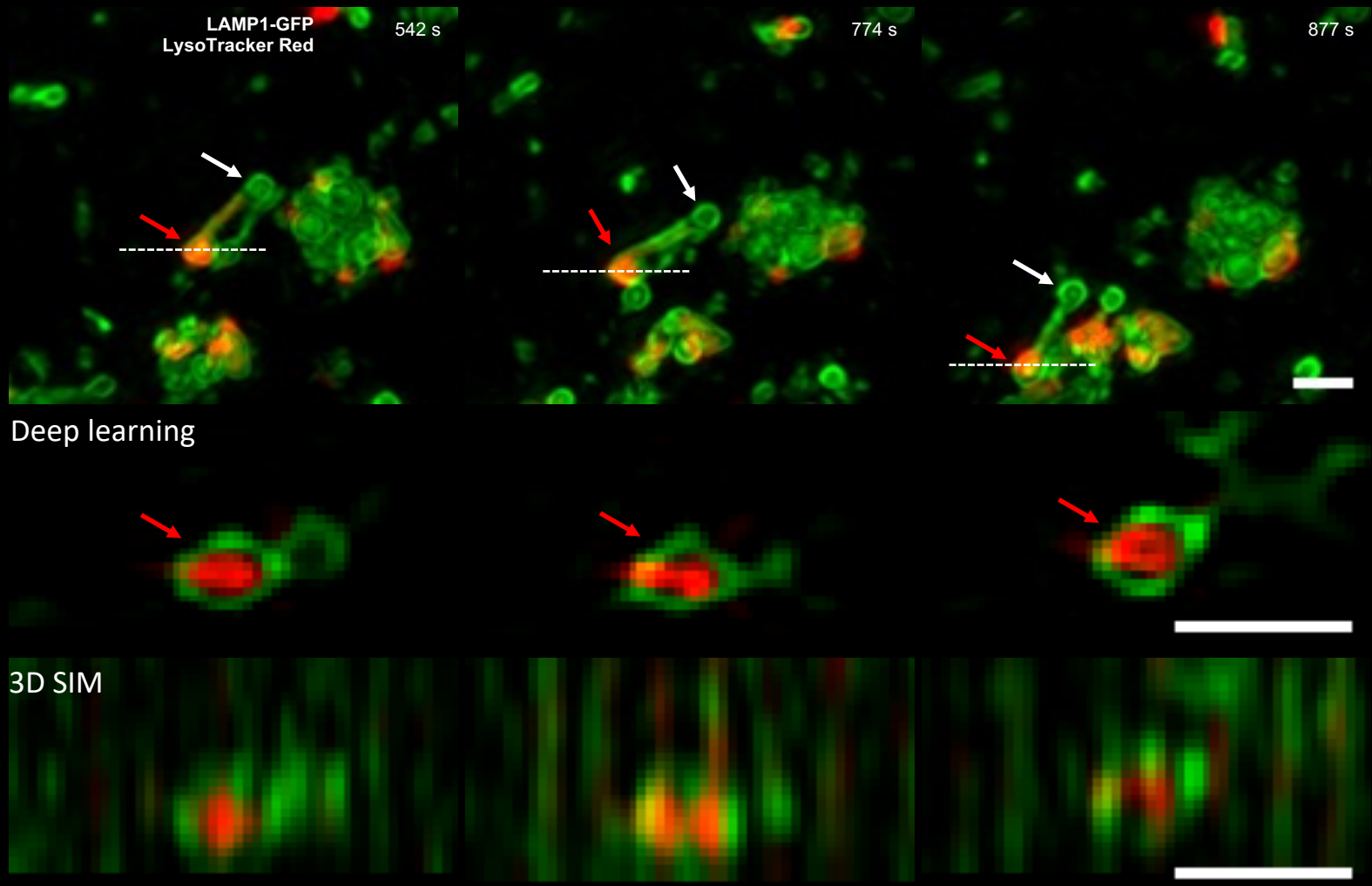




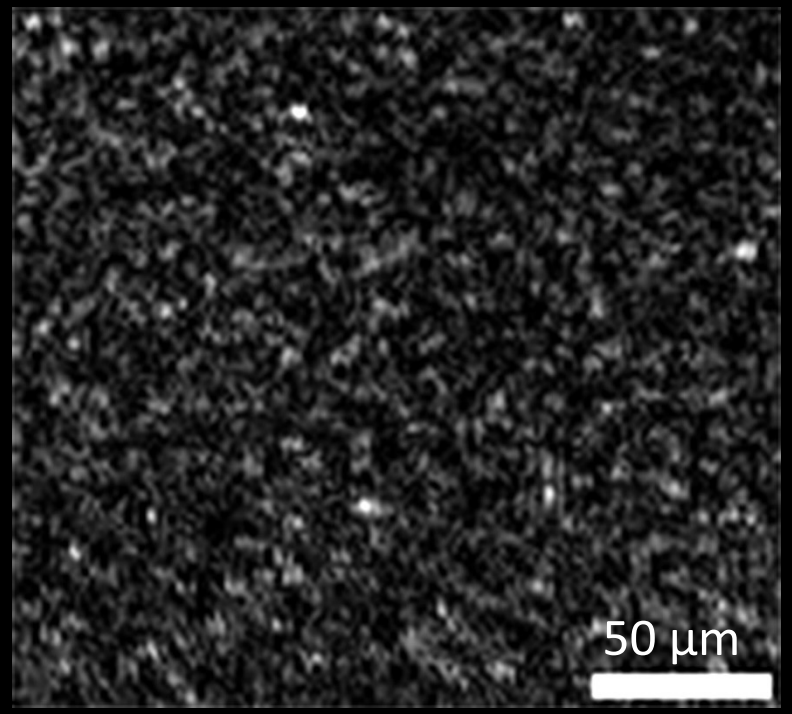
DL Enables 120 nm Isotropic Resolution



Part 2: Cloud computing for optical imaging in the eye

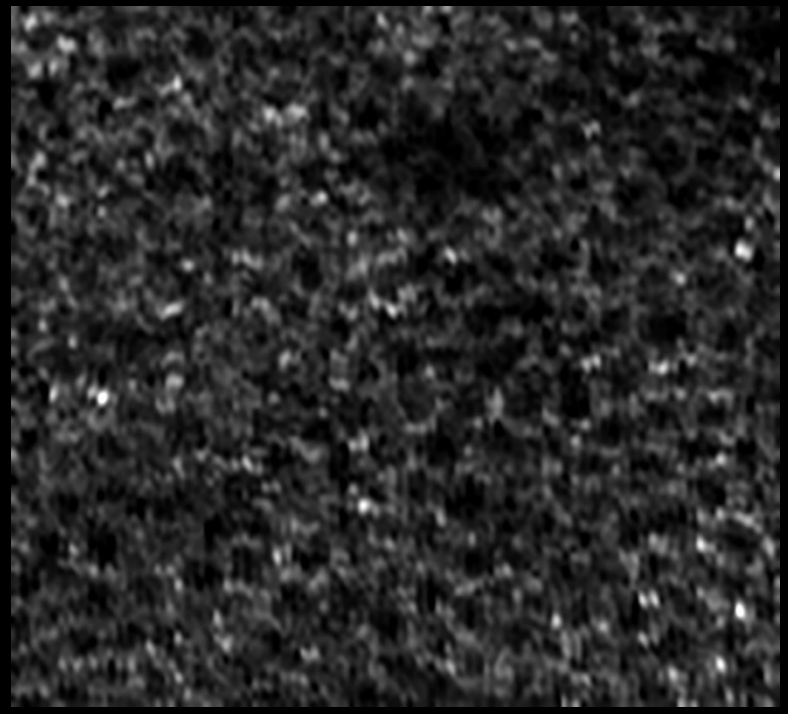
Vineeta Das
National Eye Institute

Imaging of the RPE cells



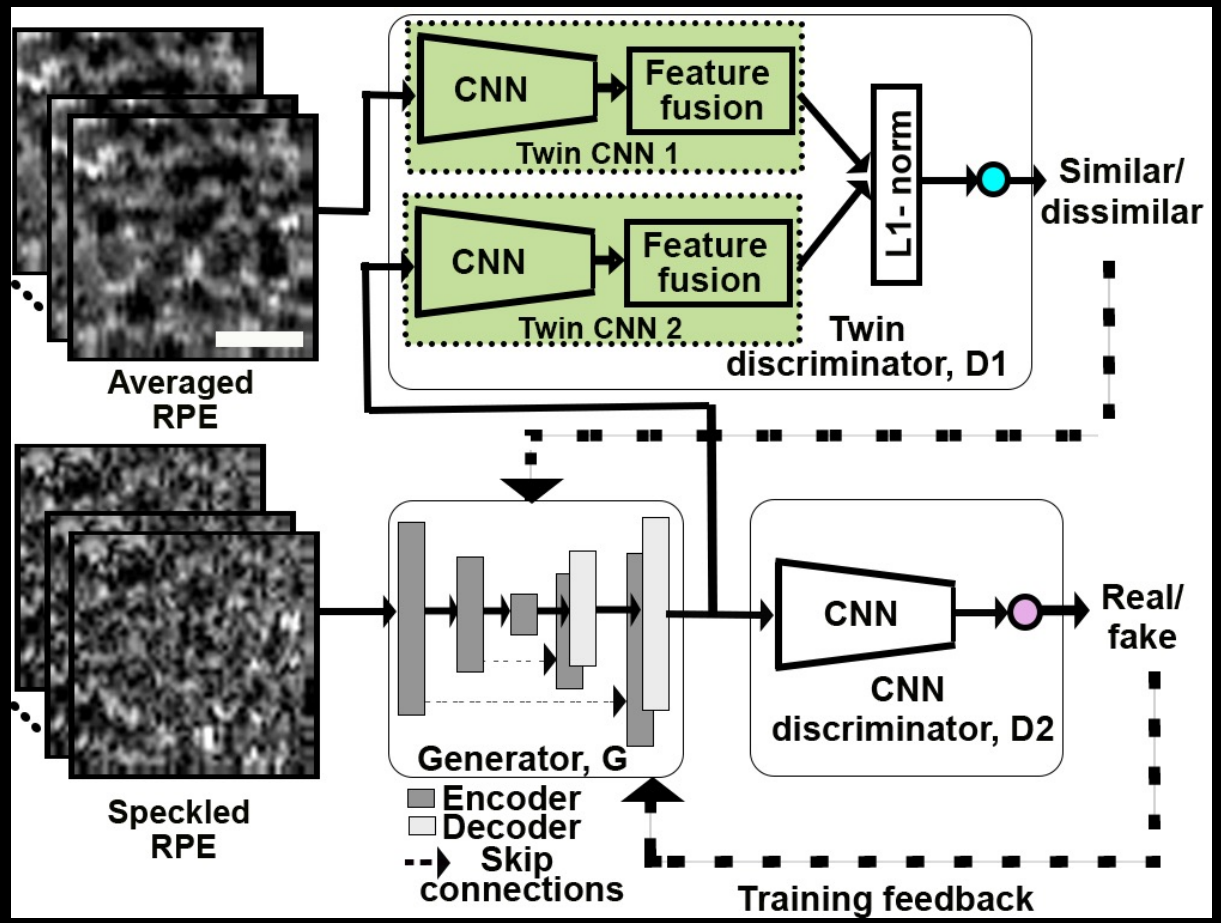
Noisy image of RPE cells

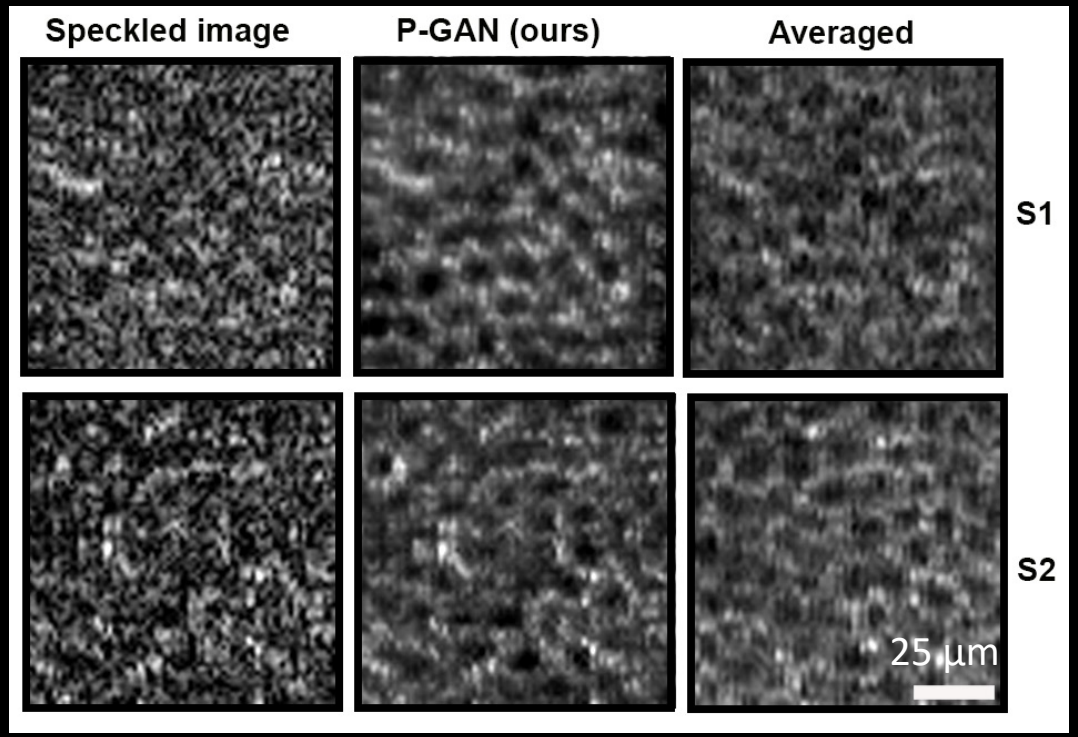
Single acquisition



Average of 120 acquisitions

Parallel discriminator GAN (P-GAN) for RPE recovery

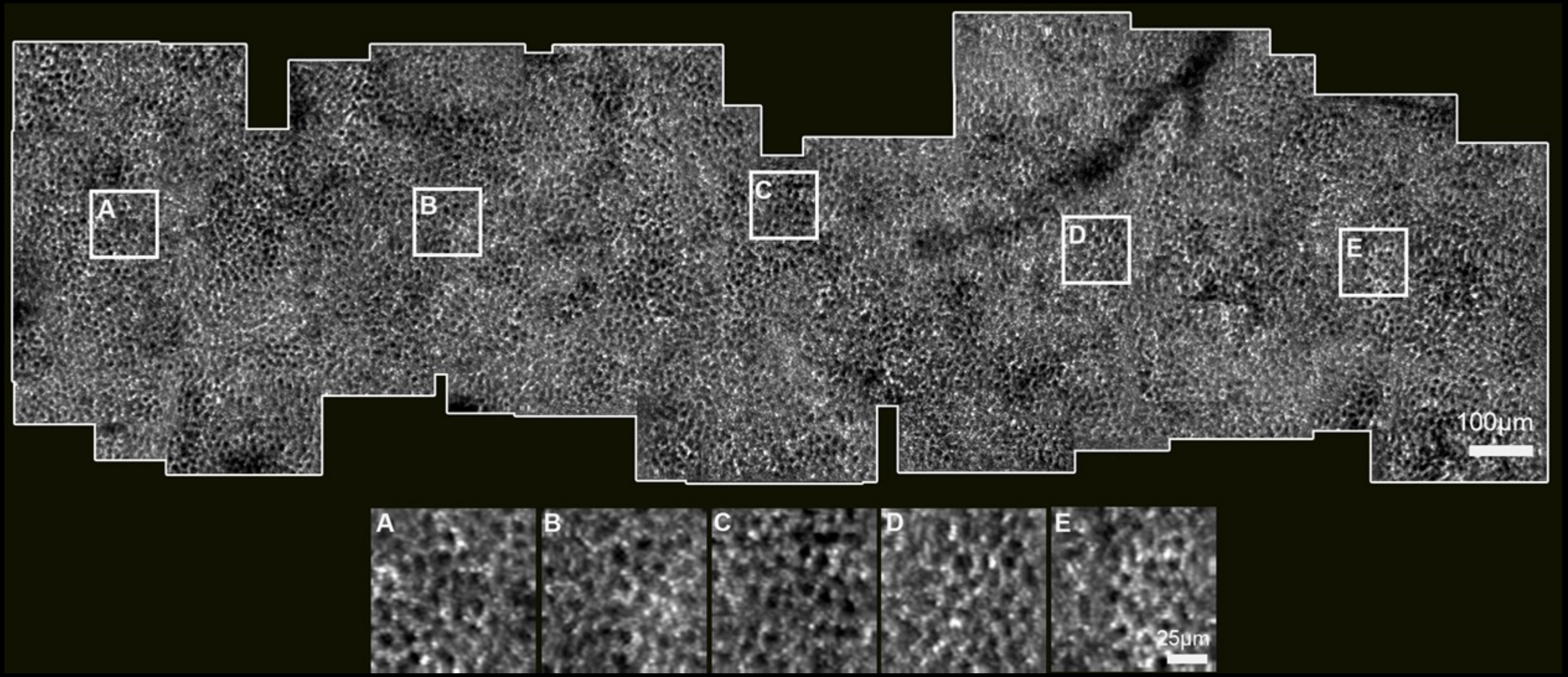




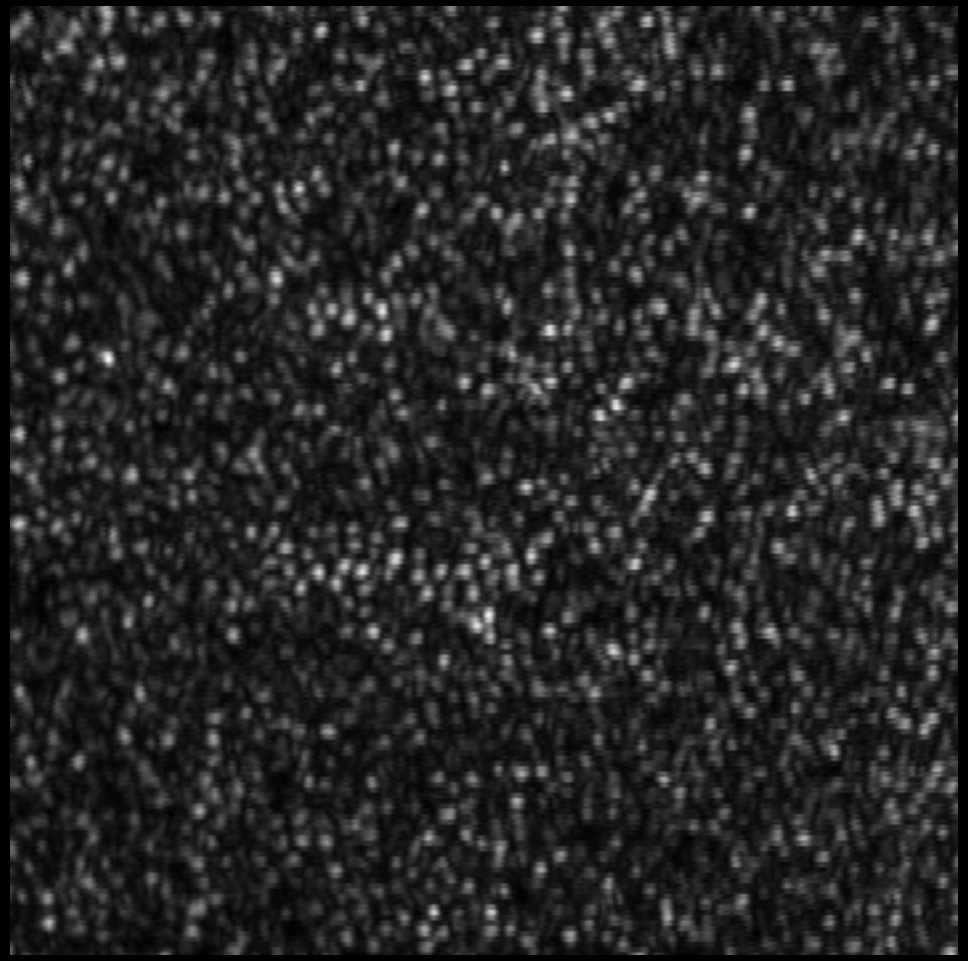
*S1 and S2 represent subjects

Vineeta Das, Furu Zhang, Andrew Bower, Joanne Li, Tao Liu, Nancy Aguilera, Bruno Alvisio, Zhuolin Liu, Daniel Hammer, and Johnny Tam, *accepted in principle to Nature Communications Medicine*

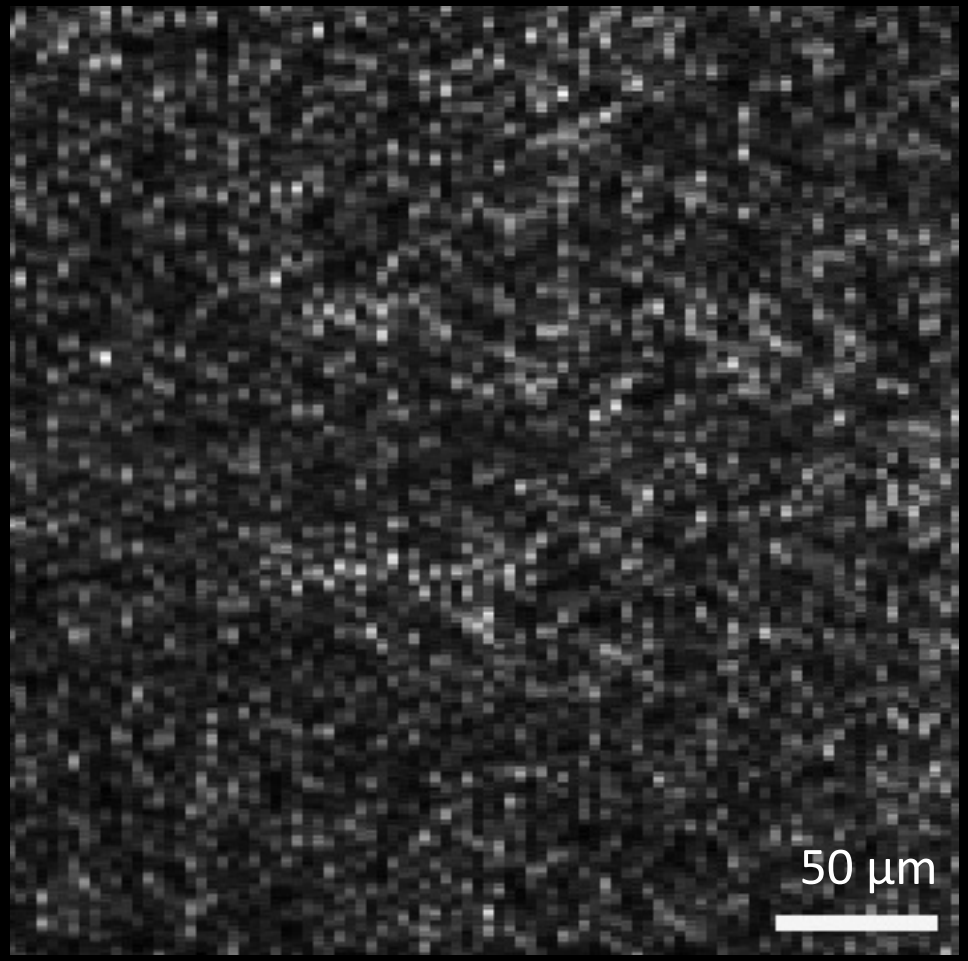
AI assisted imaging enables large scale RPE visualization



Imaging of the cone photoreceptors

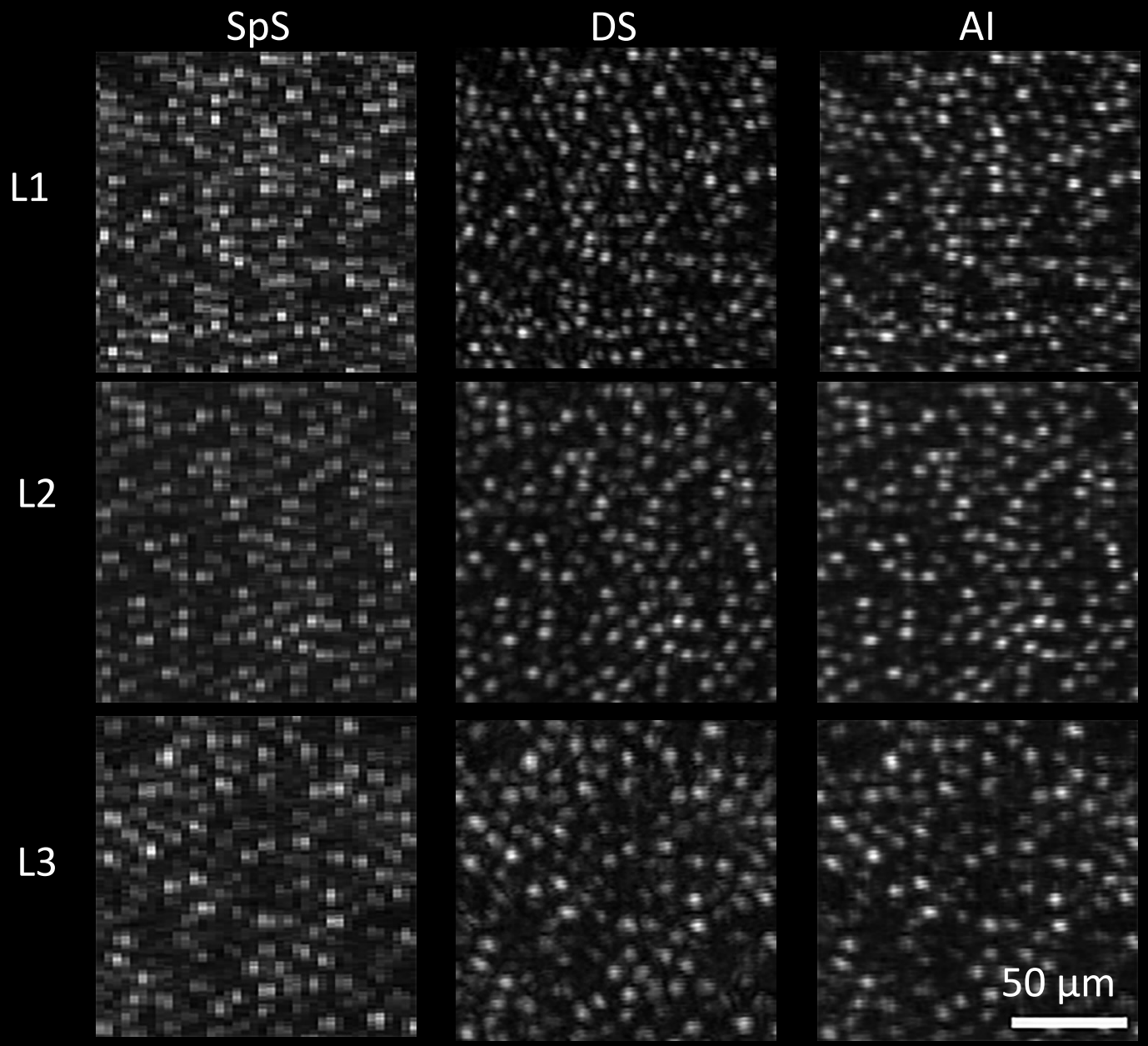


Dense sampling (DS)



Sparse sampling (SpS)

Results



Estimated cell spacing (µm)

Location	DS	AI
L1	11.5	11.3
L2	9.8	10.2
L3	8.3	8.0

L1, L2, and L3 denote regions of interest imaged at 1.5 mm, 2.1 mm and 2.7 mm temporal to the fovea, respectively.

Acknowledgements

	AIM / NIBIB	**NEI**
Current members	Harshad Vishwasrao	Andrei Volkov
	Jiji Chen	Tao Liu
	Jiamin Liu	
Previous members	*Hari Shroff*	*Bruno Alvisio*
	Yicong Wu	*Jianfei Liu*
	Xuesong Li	

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