Computational Super-Resolution Microscopy: Combining Noise Models, Regularization, and Object Sparsity to Achieve Highest Resolution

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KEY WORDS: Super-resolution microscopy, computational super-resolution, regularization

ABSTRACT

Super-resolution fluorescence microscopy has obvious benefits in advancing biological study of small structures beyond the diffraction limit. Currently, super-resolution microscopy techniques that achieve more than two times resolution improvement over the diffraction limit have generally required stimulated emission or switchable fluorophores. Using standard fluorophores and a minimally modified widefield microscope, we demonstrated [1] it is possible to achieve more than two times resolution improvement over the diffraction limit using numerical post-processing.

Following a careful examination of the imaging system, we present an algorithm with improved performance over our previous work, and present verified ground-truth results.

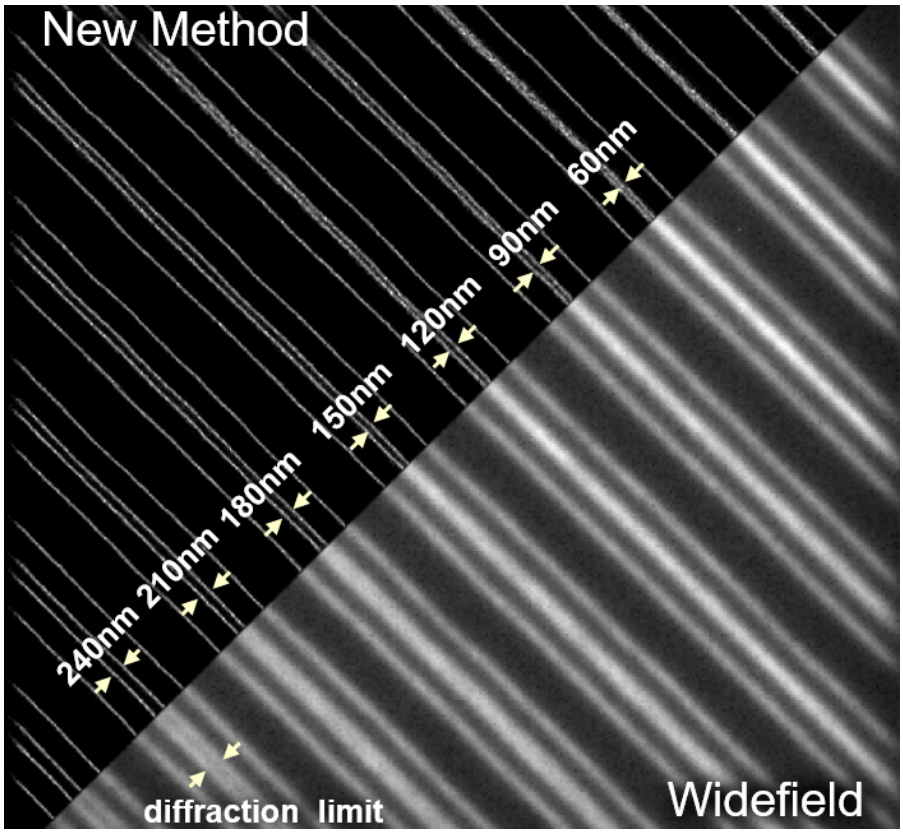

Fig. 1: Argolight fluorescent test slide shows our computational super-resolution approach can achieve 60nm lateral resolution which is nearly four times improvement over the 240nm diffraction limit. Objective: NA1.4, 100x.

[1] Yu, J.-Y., Becker, S. R., Folberth, J.,Wallin, B. F., Chen, S., and Cogswell, C. J., "Achieving superresolution with illumination-enhanced sparsity," *Opt. Express* **26**, 9850-9865 (Apr 2018).