RESOLUTION ENHANCED SOFI VIA STRUCTURED ILLUMINATION

Guangyuan Zhao*, Cheng Zheng, Xu Liu, Cuifang Kuang
State Key Laboratory of Modern Optical Instrumentation, Zhejiang University
Hangzhou 310027, China
***E-mail: guangyuanzhao@zju.edu.cn**

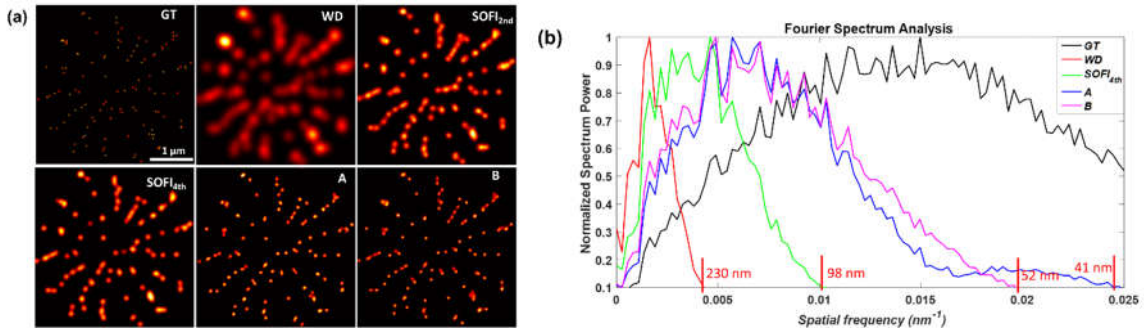
KEY WORDS: Stochastic imaging, Super-resolution, Fluorescence imaging.

1. PRINCIPLE

By analyzing the statistics of the temporal fluctuations from the blinking emitters, super resolution fluctuation imaging (SOFI) achieves super-resolution while imposing less constraints on the blinking behavior of the probes and are more suitable for low SNR acquisition than localization methods. However, determined by the square root of cumulation orders, the resolution improvement of SOFI highly restricts its promotion into high resolution observations. In this letter, abandoning the default flat illumination in stochastic imaging methods, we introduce structured illumination (e.g., Gaussian or sinusoidal pattern) into SOFI (SI-SOFI) [1] to render greatly enhanced resolution. Through simulation with parameters of both real acquisition procedure and microscope properties, we examine the feasibility of SI-SOFI and obtain a resolution improvement of 4-6 folds at just 2nd order cumulation compared to wide-field imaging. Also, a practical pathway for the SI-SOFI reconstruction is offered.

2. IMAGING VERIFICATION

Here we simulate out the labeled siemens-star like sample (a) for the qualitative test. As can be seen in (b), even in the 4th order SOFI, the resolving ability is not satisfactory as many nearby molecules cannot tell from the structure. While in the final reconstructed SI-SIM results of type A& B, the molecules that were conglomerated in the wide field images are clearly resolved. Further, we use a generalized resolution metric named Fourier Spectrum Analysis (FSA) (b) for assessing the performance, where both type A and B gain substantial enhancement in the spectrum, well demonstrating the improvement with structured illumination. The labels of the Fourier spectrum plot in (b) also evidence resolving enhancement of 2.34, 4.42 and 5.6 folds of 4th order SOFI, type B and A compared to that of wide field imaging.



REFERENCE

1. G. Zhao, C. Zheng, C. Kuang, and X. Liu, "Resolution-enhanced SOFI via structured illumination," Optics letters **42**, 3956-3959 (2017).