

Algorithm Specific Comparison of Gen II sCMOS and EM-CCD Cameras for Precision Localization Microscopy using a Camera Simulation Engine

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Light microscopy imaging is being transformed by the application of computational methods that permit the detection of spatial features below the optical diffraction limit. Successful localization microscopy (STORM, PALM, etc.) relies on the precise position detection of fluorescence emitted by single molecules using highly sensitive cameras with rapid acquisition speeds [1]. The exact nature of the final reconstructed image is dependent not only on the experimental set-up but also on the algorithm applied to the raw images.

Previously we and others reported that scientific CMOS (sCMOS) is suitable for precision localization microscopy [2, 3] and used our Camera Simulation Engine to show that Gen II sCMOS outperforms EM-CCD when applying a MaLiang algorithm [4, 5]. Here we advance our initial findings and use our CSE demonstrate that Gen II sCMOS reliably provides better precision localization than EM-CCD using a variety of algorithms and discuss these results in the context of Fisher information theory.

Our data validates our hypothesis that Gen II sCMOS, due to a combination of low read noise and high effective QE and absence of electron multiplication excess noise, offers better signal to noise than EM-CCDs at all signal levels above 4 photons per pixel [6]. Thus, Gen II sCMOS has the potential to provide more precise localization data and also offers larger field of views and faster frame rates. Furthermore, we show the usefulness of our CSE in development and optimization of precision localization experimental set-ups and algorithms.

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