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THE MIEYE: BENCH-TOP SUPER-RESOLUTION MICROSCOPE WITH COST-EFFECTIVE EQUIPMENT

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We introduce the miEye platform, a cost-effective microscope with high-resolution wide-field fluorescence imaging capabilities [1]. Advanced super-resolution (SR) imaging devices can be purchased commercially for a high cost. Affordable open-source microscopy systems frequently often support single imaging modularity, fall short of their more high-priced siblings, or lack dedicated software. The miEye design is based on a modular aluminium CNC milled microscope body that can be customized with optomechanical components that are commercially available. The microEye open-source Python package is used for microscope operation, data visualization, and analysis. The microEye utilizes commonly used iCMOS (industrial complementary metal oxide semiconductor) cameras, IR-based automatic focus stabilization, and laser control through an Arduino-based laser relay. The open-source effort seeks to make the super-resolution community's adaption and contribution relatively easy. The system cost can sum up to about 50,000 euros. It features a flexible emission path and two interchangeable excitation regimes (SM-fiber and MM-fiber). The miEye maintains less than 5 nm/min stability of lateral sample drift. After software drift correction, the miEye achieves ~10–40 nm lateral resolution for dSTORM and DNA-PAINT single-molecule localization microscopy (SMLM) experiments. The platform is a versatile and cost-effective addition to the open-source microscopy community that may enable high-quality SR imaging for research groups with limited funding.

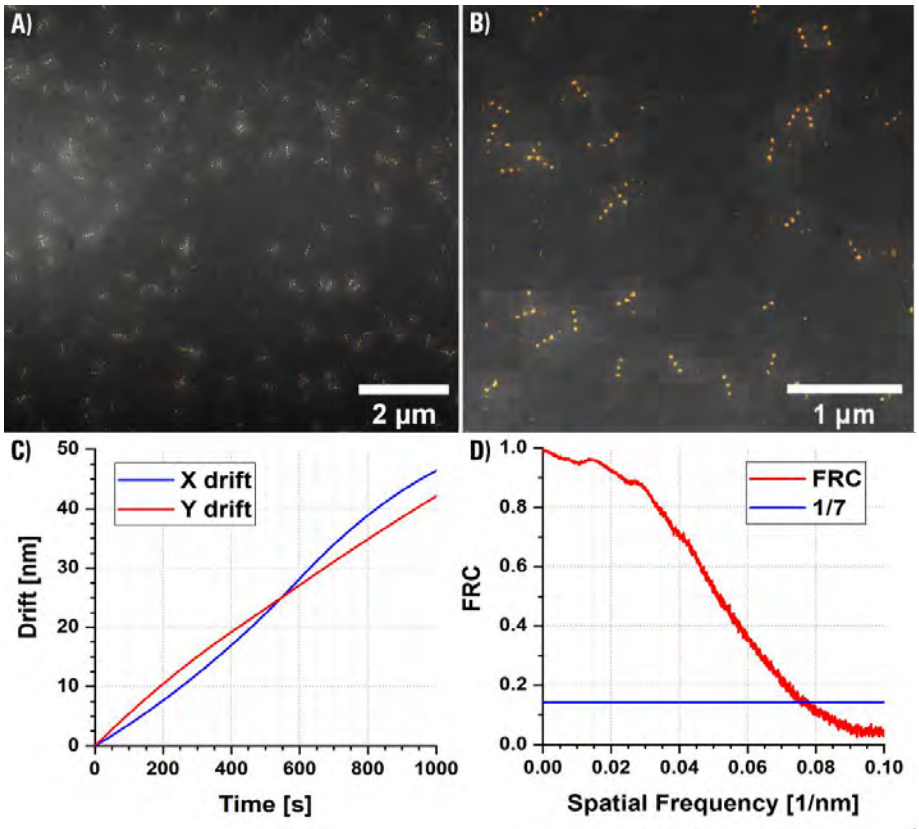

Fig. 1. TIRF microscopy image of sparsely distributed DNA nano-rulers with 80-nm spacing. Three independent imaging experiments under the 638 nm wavelength excitation were done with a similar outcome. A) Larger field-of-view (FOV) conventional TIRF microscopy average stack overlaid with reconstructed super-resolution (SR) image. B) Zoomed image of the larger FOV presented in panel A. C) Graph showing curves of X and Y drift used for drift correction using cross-correlation. D) FRC (Fourier Ring Correlation) curve, which showed a resolution value of 14.3 nm.

[1] M. N. Alsamsam, A. Kopūstas, M. Jurevičiūtė, and M. Tutkus, The miEye: Bench-top super-resolution microscope with cost-effective equipment, HardwareX, vol. **12**, p. e00368 (Oct. 2022).